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ABSTRACT

This monograph explains the new economy from the point of view of people at work. It begins by providing an overview of the new economy and places the United States in it. Separate aspects of the new economy are elaborated in five parts. Part I presents the competitive standards that provide the cornerstone for the new economic reality: robust productivity, flexible volumes, speed, affordable quality, and customer focus. Part II assesses the role of technology, especially information technology, in the new economy. Part III explains how the orderly cycles of economic change have been transformed in the new environment. Parts IV, V, and VI discuss the impact of new competitive standards, technologies, and the radical alteration caused by economic change on organizations, jobs, and skills respectively. Part IV discusses mass production structures; services, independent crafts, and professions; and examples of industries' diverse responses to organizational demands. Part V addresses how the new economy has affected jobs in three ways: quantity, distribution, and quality. Part VI discusses factors affecting skill requirements and elaborates on the skills needed in the new economy. A list of 138 references is appended. (YLB)

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AMERICA AND THE NEW ECONOMY

by
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PREFACE

This monograph is both an intellectual map and a guide to action in the new economic environment. It describes a new economy founded on a new set of competitive standards that have transformed organizations, economic cycles, jobs and skill requirements. This monograph is about the real economy of organizations, people and technology, not the statistical economy so often reported in second hand data. Overall estimates on the movement of interest rates, trade and budget deficits, job creation and other economic aggregates provide useful indices of our economic progress but tell us little about what works on the job. The dizzy heights of statistical abstraction are too far removed from the daily operations of the real economy to be of significant help to decision makers inside the workplace. Our accustomed indices of economic change are incomplete because they rely on information gathered from the outside looking in at the real economy of organizations, technology and people. Moreover, they inevitably emphasize the dead weight of past practices more than the leading edge of economic events, encouraging unwarranted comfort with the pace of our adaption to new realities.

The perspective taken here is decidedly different. It looks on the emerging economic reality from ground level; inside the present economy looking outward toward the future. The monograph guides the reader through the new economy. The journey begins with an elaboration of competitive standards in the new economy and leads on to an analysis of organizational structures, economic life cycles, technologies, job designs and skill requirements. It is intended as a map to orient economic decision makers in the unfamiliar terrain and as a blueprint and a tool kit for assembling strategies, technologies, organizational structures and skills necessary to cope, survive, prosper and grow in the new economic context.

This is not the only discussion of the new economy. Yet it differs from the others because it is comprehensive. Other discussions of the emerging economic reality usually treat some aspect of the whole, emphasizing changing competitive standards, organizations, product cycles, jobs or skills. The analysis that follows integrates the various aspects of the new economy into a cohesive frame. Each aspect of the new economic reality is discussed separately and with careful attention to the relationships between each of the parts and the whole.

The monograph begins by providing an overview of the new economy and places America in it. The body of the monograph elaborates the separate aspects of the new economy in five parts. Part I presents the competitive standards that provide the cornerstone for the new economic reality. Part II of the book explains the role of technology, especially information technology in the new economy. Part III explains how the orderly cycles of economic change have been transformed in the new environment. Parts IV, V and VI discuss the impact of new competitive standards, technologies and the radical alteration in process of economic change on organizations, jobs and skills respectively.

INTRODUCTION

The sense that we are entering on a new economic order is widely shared. The pages that follow are one more attempt to link the past and present economies to the next one. At this writing, the future economic order is perceived only dimly. We know the traits of its lineage but have little knowledge as to how these traits will recombine to form a new organic whole. Prior attempts to name our economic future have not worn well. Terms like "postindustrial economy" and "service economy" oversimplify and point us toward an economy that will not work. We will not survive by deindustrializing and "taking in each other's wash" or becoming a nation of hamburger flippers. Nor will our manufacturing industries prosper without the support of complementary service and natural resources capabilities. In short, at present naming our economic future is premature. We do know that the future economy will be new, however, so the analysis that follows refers to it simply as the "new economy."

This monograph explains the new economy from the point of view of people at work. Specifically, it examines the impact of changing competitive standards, new technologies, and emerging organizational structures on jobs and skill requirements in the American workplace. This information should be useful to both individuals and institutions. It provides a context for individuals to plan their careers. In addition, the analysis can help employers, educators, and governments adjust to new competitive requirements.

Any attempt to foretell the future runs the risk of confusing the destination and the journey. Inevitably, the analysis that follows, to some extent, confuses the processes of change with change itself. But the effort is worthwhile if, by anticipating the general trajectory of current trends, we can influence the shape of things to come. At present, the new economy is still a series of different possibilities contingent on a wide variety of choices. Once these choices have been made, the nation will be wedded to a dominant configuration of markets, strategies, organizational structures, job designs, and skill utilization. This monograph is offered in the interest of informing choices that will promote America's competitiveness and expand opportunity for her citizenry.

Anthony Patrick Carnevale
Washington, D.C., 1991

ABSTRACT

America is adjusting to the competitive realities of a new economy. The new economy is distinguished from the old economy by a new set of competitive standards. In the old economy competitive success was based almost exclusively on the ability to improve productivity. In the new economy organizations and nations compete not only on their ability to improve productivity but on their ability to deliver quality, variety, customization, convenience, and timeliness as well.

The shift from the old to the new economy results from the globalization of wealth and competition and from the introduction of new flexible technologies that allow the simultaneous pursuit of the full range of new competitive standards on a global scale.

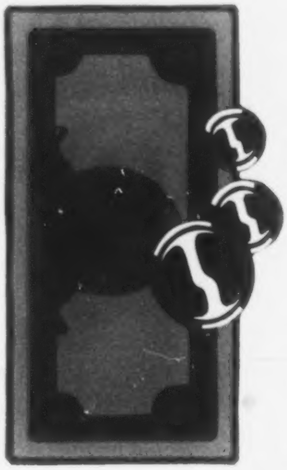
The new competitive standards and flexible technologies of the new economy need to be housed in new kinds of organizations. Both large, top-down hierarchies typical of manufacturing and smaller, isolated and fragmented structures typical of services are being replaced by flexible networks.

The new economy is creating a new structure of jobs. Organizations are using a mix of highly skilled but fewer production workers and more service workers to meet new competitive standards.

The new economy also requires a more highly skilled workforce. Workers' skills need to be both broader and deeper especially at the point of production, service delivery, and at the interface with the customer in order to meet new competitive standards and to complement flexible organizational structures and technology.

WHAT IS THE NEW ECONOMY?

The new economy is already upon us. It is pulling threads from the weave of our economic past, creating a whole new cloth. The most obvious change in the texture of the fabric is the growing complexity in the pattern of standards that we must meet in order to win in economic competition. In the old economy, nations competed principally on the basis of productivity and prices. Our success as a nation was measured by our ability to produce higher volumes of goods and services with the same or fewer resources. In the new economy, our national competitiveness is based not only on productivity, but also on quality, variety, customization, convenience, and timeliness. People are demanding high-quality goods and services that are competitively priced, available in a variety of forms, customized to specific needs, and conveniently accessible. What's more, people don't want to wait patiently for state-of-the-art products and services.



These new market standards result from profound economic and social changes in America and around the world. In the new economy, consumers are richer than in the old economy. They use more time making money than spending it. Today's consumers can afford something better than they used to. They demand, and new technologies allow, quality, variety, customization, convenience, timeliness, and mass production prices. What's more, in the global economy, if American industry doesn't meet these standards, somebody else will.

Central to the new economy are flexible and information-based technologies. In fact, today's most important technology is our friend, the computer. In its various disguises, this information-based technology raises our potential for higher productivity and quality. It provides sufficient flexibility to tailor products and services to smaller markets and even to individual customers. In addition, by integrating producers and consumers into economic networks, it helps to create an environment in which goods and services can be delivered globally or locally in a convenient and timely way.

As new economic and technical forces change the standards for economic competition, they also affect organizational structures, skill requirements, and jobs. Organizational formats are shifting toward flexible networks that use information to integrate organizations, expedite strategic changes, and improve customer service. In fact, the physical energy necessary to extract resources, manufacture products, and deliver services is becoming less important than the information required to respond to markets quickly. Increasingly, information is becoming the basic raw material of economic processes and the end product of economic activity. This shift to information networks is evident in the large hierarchies of big business and the structures of the service and small business sectors. Today's employers in large hierarchies are driving authority, skill, and resources toward production and service delivery, flattening the middle tiers of the hierarchies. In industries with typically small, autonomous, and isolated organizations, new market demands and the capacity of new information technologies are reducing fragmentation and integrating small structures into effective networks.

As the new economy emerges, the role of people at work is also changing. Capital-to-labor ratios are continuing to grow, and direct labor participation in the processes of resource extraction, manufacturing, and service provision is declining. As a result, human responsibilities and skill requirements are increasing and becoming less job specific, job assignments are becoming more flexible and overlapping, and employees are spending more time interacting with one another and with customers.

Overall, we are experiencing an increase in service functions and service jobs in all industries. The new market standards along with the declining hands-on participation of labor at work are creating a new competitive reality that emphasizes service. At the same time, unpaid household labor is being absorbed into the service economy as the value of human capital and time increases.

In the new economy, flexible work teams and information networks within and among economic institutions are the basic units of production. The demand for state-of-the-art products and services requires flexible, integrated work organizations that get innovations off the drawing board and into the hands of consumers quickly. The need to customize a wide and ever-changing assortment of products and services requires closely integrated working groups that can shift fluidly. Similarly, market demands for quality and convenience are difficult to achieve without teamwork, and the new information-based and flexible technologies result in organizations and work processes that rely on shared information. The trend toward more general and overlapping work assignments and skills forces employees to interact to meet shared responsibilities. Economic activity becomes more of a collective activity conducted by groups of people.

THE NEW ECONOMY IN HISTORICAL PERSPECTIVE

Every economic era has its characteristic signature—a dominant mode of extracting natural resources to produce goods and of providing services. Two major economic eras, craft production and industrial mass production, preceded and influenced the new economy.

THE PREINDUSTRIAL CRAFT ECONOMY

The age of craft production was characterized by the autonomy of skilled farmers, miners, and artisans. Organizations employed only a few individuals. Artisans, who occupied the upper tiers of a relatively flat occupational hierarchy, were broadly skilled and used general-purpose tools to turn out a wide variety of customized products. Each artisan usually worked in a single medium, such as cloth, wood, metal, glass, or leather. Both the mediums and the tools were subservient to the skill. The conception, execution, and control of work were unified in the individual. Remuneration was based on skill and output.

THE MASS PRODUCTION ECONOMY

The characteristic signature of this era has been the rationalization of economic activity: simplifying and increasing the scale of activity in order to provide large quantities at lowest costs. In the mass production economy, the autonomous artisan gives way to the dependent employee who works in the context of a workforce and an organization. The artisan's unity of conception, execution, and control at work is fragmented in the mass production workplace: Jobs are organized into segmented hierarchies. The machine substitutes for the artisan's tool. The human scale of cottage and shop is replaced by the industrial leviathan. The natural rhythms characteristic of the craft and farm economy give way to bureaucratic procedure and the machine cadences of the factory. The tool was an extension of the artisan's skill and purpose; the worker is an extension of the machine. The artisan was paid for skill embodied in the final product; in the mass production economy, wages are attached to jobs rather than skill or final products.

The craft economy did not disappear with the advent of mass production but has survived in an uneasy coexistence in its shadow. Markets for short-run production and specialized services have persisted. Someone has to invent and make the mass production machinery. Moreover, the mass production system requires employees with the ability to tailor machine-made products to specific uses. The pipe fitter, the machinist, and the tool and die maker are cases in point. Some industries, such as construction, have been difficult to rationalize with the available technologies and have continued in the craft tradition. Also, professional and administrative services have grown as a result of mass production, urbanization, and increased disposable income, and this growth has provided new opportunities to expand the craft model. The urge to rationalize craft and professional work through mechanization and Taylorist work practices persists, however, in the interest of greater efficiencies and cost savings.

THE NEW ECONOMY

The similarities and differences between the new economy and the craft and mass production economies are instructive. The new market standards of customization, variety, convenience, timeliness, and quality are similar to those in the craft economy. At the same time, the new economy utilizes a powerful capital base to produce craftlike products on a scale and at prices more akin to mass production than the low-productivity craft economy. The urge to rationalize economic activity and thereby extract resources, manufacture, and provide services at least cost is far from spent. The new economy retains the productivity standard and adds to it.

Unity of conception, execution, and control over work, characteristic of the craft economy but fragmented in the mass production system, reemerges in the new economy (Baran and Parsons, 1986). The employees do not work as independently as artisans did, but there are also differences from the mass production economy: Employees are more autonomous and do not work in the rationalized hierarchies typical of the mass production system. The new context for work is loosely knit teams and networks organized flexibly around information. As in the craft economy, control is exerted through common values and goals arrived at by consensus-building processes and cooperation rather than through authority-based control systems.

The new economy represents a return to craft standards for remuneration, but wages are increasingly dependent on the overall skill and performance of the group rather than the individual. "Gainsharing" and other forms of group incentives are on the rise, automatic cost-of-living increases have declined dramatically, and employees are generally more attuned to the effect of organizational performance on their earnings.

In sum, the emerging new economy retains the volume and productivity standards of mass production and marries them to the craft standards of quality, variety, customization, convenience, and timeliness. A notable difference is that autonomous artisans and anonymous mass production workers are replaced by interdependent work teams.

AMERICA IN THE NEW ECONOMY

At present, our general understanding of the new economy far exceeds its acceptance in the American workplace. In short, we know where we need to go, but we don't know how to get there. The reasons are plain enough. The path of economic progress is rarely smooth. Our path toward the new economy narrows as we encounter economic, social, technical, and political bottlenecks. Our ability to move beyond these bottlenecks, to embrace the future, will require hard choices. We have encountered other barriers in our previous economic transitions, and there is much to be learned from them. They provide the context for our current economic dilemmas. They reflect our values as a nation and our common sense of the appropriate balance between the competing claims of public and private institutions, employers and employees, and present and future generations.

Transport proved the first hurdle in the path of American economic and technical development. The interior regions of the New World were rich in natural resources, livestock, and produce. Meat, poultry, coal, and crops produced in western Ohio or Pennsylvania tripled in value by the time they reached New York, Philadelphia, or Baltimore (Liebergott, 1984, p. 93). Yet in 1800, it still took fifty-three days of hard riding to get from Detroit to Pittsburgh. By 1820, the race between the canals and the railroads was on. The canals won the early rounds. In 1825, the Erie Canal provided the first gateway to the East, connecting Ohio, Indiana, and Illinois to New York Harbor. No longer did shipments have to be moved through Montreal, where the harbor was frozen for almost four months every year (Liebergott, 1984, p. 105). The railroads finally overtook the canals as the principal means of moving goods from west to east, because the railroads were faster and could carry heavier loads.

American manufacturing was born in New England at the turn of the nineteenth century and grew over the next fifty years as a result of borrowed technology and protection from foreign competition by the artificial oceans of embargo and tariff. Yet as late as 1860, only 14 percent of Americans worked in manufacturing, whereas 53 percent still worked in agriculture. Because the preponderance of economic activity was still in agriculture, the rationalization of economic activity, usually associated with manufacturing, had its first and most powerful impact on the farm. By the time the first shots were fired on Fort Sumter in 1861, agricultural productivity had increased enormously compared with productivity rates at the turn of the century. Careful breeding had increased the livestock yield dramatically, and between 1810 and 1860, this same process of unnatural selection had doubled the fleece per sheep (Liebergott, 1984, p. 166). Over the same period, improved seed had increased the yield from a single cotton picker from fifty to almost two hundred pounds of cotton per day, and the cotton gin, a machine that separated cotton seed from raw cotton, had increased the number of cleaned bales produced in a single day eightfold. The number of hours required to produce a bushel of wheat or corn had been cut roughly in half over the same fifty years.

Rapid advances in industry arrived after the Civil War in the form of new energy sources and manufacturing processes. The principal technological bottleneck to the advance of American manufacturing was energy, and the shift from water to steam power after the Civil War and the subsequent shift to electricity between 1880 and 1930 made quantum changes in the power and productivity of manufacturing processes. Production systems became both more powerful and more flexible, ultimately moving the locus of production from rural to urban settings. New manufacturing processes developed after the Civil War also expanded output. For instance, new processes for making cheaper and better steel and aluminum increased output and reduced prices more than tenfold between midcentury and 1880.

As the nation raced toward the twentieth century, the increased productive capacity in agriculture and industry encountered new educational, organizational, and financial barriers to economic progress. As productivity increased, agriculture began shedding unskilled labor. As private industry developed off the farm, the lack of complementary infrastructure became a barrier to further expansion. The nation required an urban, industrial labor force made up of highly skilled white-collar and technical employees and blue-collar laborers. In addition, substantial investments were required to pay for railroads, roads, and the communications infrastructure that would move raw products from west to east. Urban infrastructure, including electrification and sewage treatment, demanded a huge capital outlay. Private employers needed new institutions and financial mechanisms to support the expensive technical and organizational infrastructure of mass production. In the end, the government paid for the urban infrastructure, the industrial labor force, and the roads. Private industry built new financial institutions large and powerful enough to afford private development of factories, railroads, and new communications infrastructure.

The urban industrial economy that emerged in the twentieth century relied on extensive investments in both machine and human capital from both public and private sources. But the new system also required stable production and constantly increasing consumption to justify the costs of the infrastructure and to maintain the increasingly wage-dependent urban workforce. With time, strikes and recessions proved that the new bottleneck in the development of the nation's economic system was an instability in the workplace and in consumer markets.

Eventually, managers were able to promote stability in the workplace without surrendering substantial control by paying higher wages and maintaining a more accommodating relationship with nonsupervisory employees and their unions. The stability of markets was improved by increasing the buying power of individual consumers, extending credit, and controlling national economic performance by regulating the money supply and government spending. Consumer credit, which had been available since Singer began selling sewing machines in the late nineteenth century, was offered for International Harvester's farm implements shortly thereafter and for Ford's and General Motors'(GM) automobiles in the 1920s. Further extension of credit was interrupted during the Great Depression, but credit became generally available after World War II. The Depression and the war demonstrated the need for new tools to stabilize the national market. After the Depression, a financial safety net was created for the unemployed, the underemployed, and other dependent populations, guaranteeing demand in slack periods. War production demonstrated the ability of the national government to sustain aggregate demand through the manipulation of taxation, government spending, and control over the money supply.

By the beginning of the postwar era in the United States, all the aspects of the economic system seemed to have been reconciled. Both production and overall demand had been stabilized. World War II had unleashed our economic system and gradually created a new optimism based on economic success. The hothouse economy of the postwar boom produced abundance on an unprecedented scale. The pent-up demand for consumer goods continued to stimulate the resources mobilized for war production. The result was effortless growth. Our economic system seemed to have the self-sustaining power of a social gyro. Once set in motion, it spun free at an ever-accelerating rate. Public policies braked or nudged the freely spinning wheel at the point of demand—a political convenience for a society concerned with the excesses of planned societies in the East.

The pace and path of economic development ran into new obstacles in the early 1970s. A productivity decline suggested to some observers that there was something wrong with the way we were using technology, people, and the organization of work. Others blamed the decline, at least in part, on the infusion of new female and young workers who had less experience and educational preparation than previous workers. Shortages of energy and other raw commodities proved another barrier to effortless growth in the 1970s. Bottlenecks arose in markets as well. By the 1980s, postwar productivity resulted in a saturation of mass markets at home, encouraging the globalization of competition. Eventually, global demand has been saturated as well, with a glut of production in an increasing number of industries. Growth has become stagnant since the early 1970s, and the economic and technical arrangement rooted in the industrial revolution seems to have exhausted the possibilities for stabilizing either production or markets.

As we enter the last decade of the twentieth century, the nation is breaking a path toward the new economy. But numerous new obstacles impede our progress and have become the focus of enormous social, economic, and scientific energy as pressure for growth continues to build.

Inside the workplace, flexible technology needs to be matched with more skilled and autonomous workers and work teams. New, more flexible work organizations that drive authority and resources toward the point of production, service delivery, and the customer are also required if we are to take advantage of the inherent potential of new human and machine combinations.

Barriers that impede progress toward the new economy are apparent outside the workplace as well. Environmental limitations to growth await a technical solution. The new economy is emerging in the midst of a financial dilemma—one that is fraught with savings-and-loan bail-outs, junk bonds, and foreign debt. Also, although the new economy will require massive public and private investments in the nation's human, organizational, and technical infrastructure, the financial capital necessary for this overhaul is being absorbed in an orgy of public and private consumption. In addition, it is increasingly clear that our ability to stabilize domestic markets is no longer enough; the new economy has gone global, and global economic events tend to affect and impinge on our domestic economy. The unpredictability of global economic events requires new mechanisms for stability. Finally, the demographic surpluses of the 1970s are giving way to longer term demographic scarcity. The number of available workers is declining rapidly. Moreover, more employees will come from populations in which our human capital investments prior to work have been insufficient (Johnston and Packer, 1987).

We can be cautiously optimistic about the American prospect in the new economy. Much will depend on our ability to break through the barriers. Other nations face many of the same obstacles, but we move into the new economic era with the additional burden of our past successes. Old and once successful habits die hard. We set the standards in the old economy. The United States labors on toward the new economy, however, dragging the dead weight of our past industrial successes along behind.

The pages that follow attempt to provide a more complete description of America and the new economy. The discussion will weave the more obvious threads of past and present into a new cloth. Because the past, present, and future are so inextricably bound, the past and present economies will be used throughout as reference points to describe the emerging economic reality.

There is no logical spot to break into the seamless weave of forces that are creating the new economy. There are many strands to choose from in unraveling the fabric of economic change. What's more, the forces of change are hopelessly tangled. It is impossible to separate changes in markets, technology, strategies, organizational structure, job design, and workforce quality. Therefore, the examination that follows begins with a discussion of the increased breadth and depth of standards for competitive success in the new economy. Arguably, markets are a good place to start because they represent the separate strands of the economic system made whole. Part II of this monograph discusses the special role of technology in the new work environment, and Part III examines the changing nature of the economic life cycle. Parts IV, V, and VI examine the impact of the emerging economic reality on organizations, jobs, and skills, respectively.

THE NEW MARKET STANDARDS

PART I

Markets are the nexus where producers and consumers come together. A market represents the distillation of human wants and needs into material goods or services. Moreover, markets are a relatively uniform motif in the disjointed pattern of economic change. The basic human wants and needs expressed in markets do not vary much over time: food and drink, housing, health care, education and training, communication, transportation, entertainment, community, physical and emotional security, and safe and pleasant surroundings. Ultimately, the new economy will be measured by its ability to satisfy these timeless wants and needs efficiently and fairly.

Market Standards: A Thumbnail History

In 8000 B.C., humans settled down to farm (Grayson and O'Dell, 1988, p. 49). Early agricultural production was used mostly for subsistence or to pay tribute or rents and was rarely sold competitively. Competition and competitive standards were primitive. Subsequently, in 4500 B.C., small communities and tool-based manufacturing appeared along with early crafts (Grayson and O'Dell, 1988, p. 50). The labor-intensive craft and agricultural economy developed gradually over the next several hundred years. Competition in agricultural markets accelerated slowly with urbanization, as townspeople created a growing demand for farm surpluses.

Output per person remained relatively flat until the eighteenth century—10,000 years after the first farms (Grayson and O'Dell, 1988, p. 51). Thereafter, the economic history of the world is the story of ever-expanding consumption of goods and services as the frontiers of human wants and needs receded before the onslaught of increasing productivity.

Productivity—the ability to get more with the same or fewer resources—has been a self-starter ever since. Supply and demand have been like the proverbial chicken and egg. Selling products and services has generated spendable earnings to fuel further expansion. With the aid of productivity increases and invention, expansion continues to elude the limits to growth. The spiral of relatively effortless growth has dumbfounded naysayers from Malthus to The Club of Rome, as one doomsday after another has been posted, come, and gone; and the world still hasn't run out of land or gas.

THE MASS PRODUCTION ECONOMY: MEETING THE PRODUCTIVITY STANDARD

The astonishing productivity growth that began in the eighteenth century and continues today stems from the genius of mass production. In the mass production system, products and services are reduced to their smallest and most reproducible parts. Machines are then designed to make each individual component. In the stereotypical mass production institution, white-collar and technical elites invent standardized products, design production jobs and machinery, and orchestrate the piecemeal output of specialized workers and narrow-purpose machines within carefully organized top-down hierarchies.

The mass production economy feeds upon itself. The degree of specialization is limited only by the volume of output. Higher volumes justify the cost of ever more specialized machinery and workers. Higher volumes also justify lower prices, which in turn expand market sizes, allowing more mass production.

The mass production model is usually associated with manufacturing, but as the dominant and most successful economic paradigm, it has been tried in all sectors of the economy since its inception. The mass production model invaded agriculture, mining, and other natural resource industries early and continues to have its greatest successes there.

Craft and service work has been less amenable to mass production techniques. The crafts have not disappeared with the evolution of mass production, but continue in areas of economic activity where mass production techniques have yet to penetrate, such as in the apprenticeable trades. Yet the apprenticeable trades coexist uneasily with mass production, especially in manufacturing—working cheek to jowl with the mass production system that would deskill them if it could find a way. The mass production model has been most difficult to implement in services, because it is so difficult to standardize service delivery en masse. To the extent possible, however, industries such as finance, insurance, transportation, public services, and health care have organized large hierarchical structures to take advantage of service delivery on a large scale.

Productivity is the competitive standard of the mass production economy, and goods and services are ever more available and cheaper. The Dutch were the world's first productivity leaders, setting the pace beginning in 1700. The British surpassed the Dutch in 1785, and the United States took the productivity lead from the British in the 1890s (Grayson and O'Dell, 1988, p. 61). We have set the world standard for mass production techniques and productivity since then.

THE AMERICAN POSTWAR ECONOMY

Our productivity performance peaked in the American boom after World War II. The pent-up demand for consumer goods in the postwar era, in combination with manufacturing infrastructure built for war production and nurtured out of harm's way, pushed America's productivity performance to unprecedented levels beginning in 1946. The hothouse economy of the postwar boom made it seem as though Americans could produce goods and services on such a grand scale that material want would eventually be drowned in a sea of resources. Our abundant society was both an economic and a political miracle. It short-circuited the two toughest questions facing any society: Who gets what? and What do we do first? There was enough for everybody; all that was required was "an equal opportunity" to share in the largesse of productivity. Abundance also solved the priority problem because there was sufficient wealth to afford a cornucopia of both public and private goods. New needs could be funded without reducing existing shares in the growing economic pie.

Our successes set the tone for relationships between government and industry as well as labor and management. Cooperation was unnecessary. Rather, success created an environment of peaceful coexistence punctuated by episodes of hostile bargaining, with each party minding its own interest in dividing up the growing economic pie.

The government played a positive but distant and aloof role in the management of the economy, while preserving private ownership. Government policies manipulated macroeconomic aggregates, leaving the day-to-day management of businesses to private employers. The government's macroeconomic policies emphasized the manipulation of aggregate spending and the availability of an expanding supply of money. The government stimulated economic growth from a distance by moderating the amount of income available for spending. Spending translated into demand for goods and services and stimulated production, and production generated employment and more income for spending.

Our public economic policies encouraged stable growth, stable prices, and employment by controlling the general supply of money and regulating government spending and taxation in order to moderate the overall balance between savings and investment. Income growth also resulted in public revenues that eventually had to be spent before they became a fiscal drag on the economy. These revenues could be used to paper over the social failures of the economy and pay for its negative external effects, such as environmental pollution and unemployment.

Similarly, after the "Red scare" in the early fifties, American unions separated themselves from strategic concerns in the workplace. Managers ran the businesses while unions focused on getting better working conditions and a fair share of the growing profits. Not all agreed; for example, the auto workers' Walter Reuther continued to argue for more worker involvement in business decisions. Labor leaders of Reuther's stripe were called "redheaded"—a reference to Reuther's red hair and radical ideas.

Our productivity performance and the abundance it produced became the centerpiece for our claim to global leadership. American political and economic institutions, as much as goods and services, became a principal export. Our economic success demonstrated the superiority of democratic individualism as opposed to the collectivist cultures to the east. Global relationships were intended to leverage our way of life more than our exports. Trade policies were politically and ideologically driven rather than developed with the national economic interest in mind.

The postwar boom was supposed to launch the "American Century" and the "end of ideology." Our principal problem, as we ran pell-mell toward the "postindustrial society" in which productivity made work unnecessary, was to provide for meaningful leisure (Bell, 1983). Many facts demonstrate our postwar success. For instance—

- In 1945, Europeans were living on 1,500 calories per day and Asians on 1,000. The average American consumed close to 3,500 calories per day.
- In 1947, the United States produced half the world's manufactured goods,

57 percent of its steel, 43 percent of its electricity, and 63 percent of its oil.

- Also in 1947, U.S. citizens owned three-fourths of the world's cars, and U.S. companies manufactured 80 percent of the cars built.
- By the 1950s, most of the world's gold supply was safely stored in Fort Knox (Carnevale, 1985, p. 44).

MEANWHILE, IN EUROPE AND JAPAN

As the Europeans and Japanese dug out from under the rubble in the 1950s, their first instinct was to follow the American example. But copying our mass production system proved more difficult than first supposed. The war had taken a fearful toll. Also, the Europeans and Japanese had profound competitive liabilities. Primary among them was the relatively small size of their consumer markets. The American market was eight times the size of the next largest domestic market. The scale economies of mass production could be realized fully in the United States without going offshore and competing abroad. In Europe and Japan, however, domestic markets were too small to permit an emphasis on high-volume production of standardized goods for domestic sales alone. As a result, European and Japanese companies were forced to sell abroad.

The complexity of international markets forced the Europeans and Japanese to pay more attention to their diverse customers. German car manufacturers, for instance, had to produce cars not only for Germans but for Swedes and Italians as well. The Swedish market demanded cars for harsh winters and rural driving. Fuel efficiency was not a prime concern because gas taxes were low. In Italy, however, the climate was more forgiving and driving more urban, gas taxes were high, and registration fees were based on engine sizes (Womack, 1989, p. 19). The German car makers learned to produce weather-resistant cars for Swedish consumers and lighter, more fuel efficient cars for the Italian market.

Fragmented markets forced the Europeans and Japanese to focus on flexibility—toward human resources and machine technologies—in order to provide a variety of goods and services tailored to market segments. Also, because the Europeans and Japanese could not realize economies from the sheer scale of production, they were forced to adopt more complex competitive strategies and looked for market niches. Rather than confront the United States head-on in the large-scale mass production markets, they took the path of least resistance. The Europeans offered the Volkswagen Beetle instead of big gas-guzzlers. Similarly, mimicking MacArthur's strategy of leapfrogging across the Pacific by avoiding major Japanese strongholds, the Japanese decided, as MacArthur did, to "hit 'em where they ain't." The Japanese entered American markets by gaining a toehold in niches neglected by the domestic American producers, often after taking on the Europeans first.

To compensate for their inability to realize American productivity and scale economies, the Europeans and Japanese focused on quality. Also, if they couldn't reduce costs per unit of output simply by increasing volume, they achieved alternative savings. For example, they reduced the costs of reworking products by increasing quality in production; they focused on effective work processes, flexible organizational designs, and superior integration of human and machine capital.

Our competitors also had to compensate for the natural American advantages on the human side of production. The Europeans and Japanese had fewer, less-qualified workers as they entered the postwar competition. The glut of American workers, especially as the baby boom entered the workforce in the 1960s, allowed American employers to substitute unskilled labor for more expensive human capital. The relative paucity of labor, especially skilled labor, in Europe and Japan encouraged a more careful utilization of human capital and a more aggressive focus on learning at school and on the job (Dertouzos, Lester, and Solow, 1989, p. 24). In addition, American technical personnel, homegrown and imported, were of a superior quality, and the sheer size of the U.S. population guaranteed a greater quantity of white-collar and technical employees. As a result, the Europeans and Japanese couldn't compete in the development of major innovations. Instead, they focused on the exploitation of new ideas. Rather than expend their resources on inventions, they competed on the basis of their ability to develop new applications quickly.

The Europeans and Japanese also had to compete against the flexibility of American labor markets. In Europe, a strong craft tradition and a powerful left-wing political movement considerably reduced the employers' authority to hire, fire, and redesign work. In Japan, employers were forced to provide "lifetime employment" to blunt the more radical policies of a powerful Marxist labor movement, especially in industries manufacturing internationally traded products. American employers were able to reduce costs by shedding skilled labor and substituting mass production machinery in combination with unskilled labor. In sharp contrast, the Europeans and Japanese were forced to treat labor as a fixed cost of production and could not easily eliminate expensive skilled labor by substituting machinery and less skilled labor. As a result, the Europeans and Japanese had powerful incentives to develop and use human capital, whereas American employers were encouraged to rely on special-purpose machines and unskilled labor to drive productivity.

The Europeans and Japanese also found it difficult to match the sheer quantity of American intellectual and financial capital. In relative terms, America has never been a leading saver or investor, yet the United States is so large and wealthy that setting aside even a modest proportion of its gross national product (GNP) for investment results in more capital available per worker than in other nations. In the 1950s, for instance, Japanese families saved three times as much of their income as American families, but earned only one-eighth as much. As a result, total investment was twice as high in the United States as in Japan. Similarly, the United States made relatively low investments in intellectual capital, but because of sheer size fielded the world's largest group of white-collar and technical workers and largest cache of basic research resources.

To compensate for America's advantages in the scale of intellectual and financial resources, the Europeans and Japanese tried to make better use of their smaller quantities of resources. They turned to networks both within and outside employer institutions. While government, business, and labor in the United States bargained over shares in the growing economic pie, government, labor, and business in Japan and Europe joined together to make the pie grow, forging more tightly integrated relationships among development, design, production, and delivery than in the United States. Japan and Europe encouraged cooperation between managers and labor, strengthened linkages between employers upstream and downstream in the production process, and fostered relationships between institutions that provided critical intellectual and financial capital. Governments played a critical role in these networks by promoting research, disseminating best practices, and acting as arbiter among competitors.

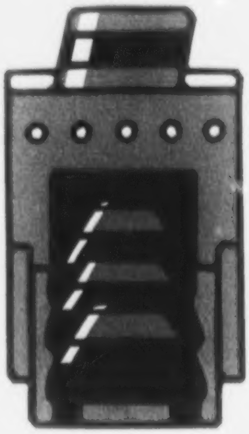
The Europeans and Japanese also compensated for a lesser quantity and quality of human resources by devising ways to make more effective economic use of these resources. The United States was good at educating and utilizing white-collar and technical elites, but students who were not college bound received second-rate educations and were given relatively little responsibility or opportunity to develop on the job. This system was consistent with the mass production economy that employed white-collar and technical elites in responsible positions at the top of institutional hierarchies and relegated nonsupervisory workers to narrow tasks at the bottom.

The Europeans and Japanese organized their educational systems and workplaces to make more effective use of non-college-bound students and nonsupervisory workers. The Europeans built elaborate apprenticeship structures that mixed work and learning. The Japanese provided high-quality elementary and secondary education to both college- and non-college-bound students. In the workplace, employees and their representatives shared responsibility and authority in an evenhanded exchange among team members up and down the line.

Our competitors also carved a more applied point on their intellectual pencil, focusing scarce financial and intellectual resources on real-world questions. Product development and process innovations were emphasized over basic research, and applied learning was emphasized at school and at work. The European use of apprenticeship, the Japanese use of group processes in school, and the emphasis on problem-solving teams on the job in both Europe and Japan are obvious examples of this applied focus. In contrast, American schooling sequesters students from the real world, breaks knowledge down artificially into theoretical disciplines, breaks disciplines down into component pieces, and demands that students commit fragments of knowledge to memory. Applications are reserved for pen-and-paper exercises at the back of the chapter. Interdisciplinary applications are rare, and applications in the context of working groups are even more rare. At work, new products, technologies, and work processes are installed from above and implemented below. There is little emphasis on capturing knowledge while the product is made, the service is delivered, or the customer is served.

Something Happened: The Effect of New Market Forces

Something happened as we entered the final decades of the American Century. We still held the lead in the productivity race, but many of our competitors were running faster and threatening to overtake us by the turn of the century. More disturbing was the fact that we were losing market share in many industries and product lines despite our superior productivity. Apparently, productivity was still a necessary condition for competitive success, but no longer sufficient by itself to capture and retain market share.



By most reports, the Europeans and Japanese seemed to have turned their weaknesses into strengths. By pursuing quality, variety, customization, convenience, and speed in getting to market, they not only expanded the terms of competition beyond productivity but found new routes to productivity as well. For instance, by designing quality into products as they were made, the Europeans and Japanese reduced the need to rework products and curbed waste, ultimately increasing productivity as well as quality. By the mid-1970s, mounting evidence began to suggest that productivity, on the one hand, and quality, variety, customization, convenience, and rapid change, on the other, were not only compatible but also mutually reinforcing competitive standards. Mass production was not the only route to competitive success.

Somewhere along the way to the second American Century, the rules of the economic game had changed. The fundamental restructuring of the standards of economic competition in the postwar era has many roots, but principal among them are the following:

- the increasing wealth of nations,
- the globalization of economic activity,
- the diversification of taste,
- the increasing value of human time,
- the commercialization of free labor,
- the increasing participation of consumers in production and service delivery, and
- technical advances.

THE WEALTH OF NATIONS

One reason people are demanding more is because they can afford more. The buying power of the average American has grown enormously since the end of World War II. The average car, for instance, was five times as expensive in the 1980s as in the 1950s. But to afford such a car, the average family had to work twenty-six weeks in the 1950s and only twenty-three weeks in the 1980s. Moreover, the average car in the 1980s was of much higher quality and usually included a number of additional features: a digital radio, air conditioning, and generally superior performance in the powertrain and assembly. In general, American workers had to work only half as many hours in 1988 as in 1950 to buy the same basket of goods (see Table 1). Of course, not everything has become a better deal. For instance, we have to work more to buy used cars, public transportation, health care, and medical insurance.

TABLE 1

Percentage Change in Hours of Work Required to Buy Goods and Services

	1950 to 1960	1950 to 1970	1950 to 1980	1950 to 1988
Durable Goods				
New Autos	-79	-51	-41	-36
Used Autos	+118	-105	-116	+144
Furniture and Household Equipment	-62	-38	-28	-21
Nondurable Goods				
Food	-76	-62	-63	-57
Clothing and Shoes	-70	-56	-39	-31
Gasoline and Oil	-78	-56	+96	-52
Tobacco Products	-83	-75	-61	-81
Services				
Housing	-81	-61	-57	-60
Electricity	-69	-46	-54	-52
Gas	-84	-58	+96	+91
Water	+110	-98	-104	+124
Mass Transit	+111	+121	-96	+116
Bus Ticket	-88	-72	+89	+104
Airline Ticket	-74	-57	-67	-64
Hospital Care	-90	-88	+93	+107
Physician's Care	-93	-91	+98	+118
Dental Care	-85	-77	-76	-81
Health Insurance	-71	-70	-57	+87
Private Education	-86	-76	-84	-82

How to Read This Table: It took 36 percent less work time in 1988 to purchase a new auto than it did in 1950. It required 144 percent more work time in 1988 than it did in 1950 to purchase a used auto. *SOURCE: (Kelly, 1989).*

The increase in the wealth of Americans is not all good news. Most of the increase in earnings occurred prior to 1973. The earnings of the average fifty-year-old American male went from $15,529 in 1946 to $32,701 in 1973 but had increased only to $36,228 by 1986 (Levy, 1987, p. 113). Average family income doubled from roughly $14,000 to $28,000 between 1950 and 1973, growing at an average annual rate of 3.1 percent, but then stagnated at a growth rate of 0.9 percent between 1973 and 1979 and 0.3 percent between 1979 and 1987 (Litan, Lawrence, and Schultze, 1988, p. 4).

The sources of income growth are equally disturbing. Until 1973, productivity drove income growth, but since then other factors have been responsible. Americans are not earning more now because they are working smarter. They are working harder. Although the average hours at work per week has declined for most European and Canadian workers, Americans have consistently worked about forty hours per week throughout the postwar period (U.S. Congress, 1988, p. 69). Only the Germans, Dutch, British, and Japanese work more hours. We're also increasing family incomes by putting more family members to work. Over the postwar period, participation in the labor force has declined from roughly 85 percent to 75 percent of men, but among women, participation in the labor force has increased from roughly 30 percent to almost 60 percent. We have learned to spread our money further by marrying later and having fewer children. Americans are marrying two years later on average than in the 1950s, and there is roughly one less person in the average household (Levy, 1987, p. 143).

Americans have increased their buying power, especially since 1980, by spending more, saving less, and borrowing. Average net savings stayed around 7 percent throughout the postwar era until 1980, but then plummeted toward 1 percent, where it has stagnated ever since (Litan, Lawrence, and Schultze, 1988, p. 51). Until the 1980s, Americans produced sufficient savings to pay all their debts and still hold a savings surplus of between 3 percent and 7 percent of the GNP. Since 1980, we have lost our savings cushion altogether, and we are now forced to borrow an amount roughly equivalent to 3 percent of our GNP from foreigners to make ends meet (Litan, Lawrence, and Schultze, 1988, pp. 33-34). Since 1980, the Federal debt has tripled, not counting another $250 billion we have to borrow to bail out failed savings and loan institutions. Household debt has gone up from $1.6 trillion in 1980 to $2.6 trillion in 1990. Over the same period, corporate debt has increased from $1.0 trillion to $1.6 trillion. In 1980, the United States was a net lender to the rest of the world—the world owed us $106 billion. In 1990, we owe the rest of the world more than $500 billion.

The increased buying power of Americans has been more than matched by improved buying power around the globe. In 1950, the average West German family earned only 40 percent as much as the average American family. By 1986, this figure had increased to 84 percent. The average Japanese family earned only 17 percent of the earnings of the average American family in 1950, but 77 percent in 1986 (Smith, 1987, p. 35). The Japanese domestic market, which was one-eighth the size of the U.S. market in the 1950s, is now almost half the size of the U.S. market (Dertouzos, Lester, and Solow, 1989, p. 25). By the mid-1980s, the earnings of the average French family were 79 percent of the earnings of the average American family; corresponding figures elsewhere were 66 percent for the British, 54 percent for the Italians, and 47 percent for the Soviets.

GLOBALIZATION

As everyone knows by now, the genie of international trade has long been out of the bottle. The combined value of imports and exports is equivalent to roughly a quarter of our GNP. The trend toward globalization is rooted in a variety of factors:

- Tastes have been homogenized as earnings have equalized worldwide; media, marketing, and travel have integrated demand.
- Higher incomes have given rise to international markets for national

specialty products and services, such as Italian textiles, Swiss watches, and Japanese consumer electronics.

- A worldwide reduction in trade barriers began in the 1950s and has continued through the 1980s despite painful trade-related dislocations (Doz, 1987).
- Advances in communication and transportation technology have allowed multinational companies to serve large, homogeneous international markets from the home country, allowed decentralized worldwide production and sales, and reduced the costs for the newly industrializing nations to enter markets (Vernon, 1987, p. 161).
- Organizational experience in American, European, and Japanese multinational corporations allowed rapid expansion when global markets became robust after the mid-1960s.

By the mid-1960s, the latter conditions resulted in the potential for rapid globalization. The spark that ultimately ignited global competition was the need to find new markets for mass-produced goods when existing markets became saturated. Increased productivity in combination with the natural cycles of boom and bust in domestic markets began to create persistent oversupply in the mid-1960s. As domestic markets became saturated, more and more nations began to compete for international customers. Because of increased mass production around the world, the list of basic commodities, products, and services that are oversupplied has grown constantly. By the late 1980s, production exceeded demand by at least 20 percent in steel, petrochemicals, semiconductors, and cars (Stokes, 1986). In a perfectly functioning free market, a glut would drive down prices and the least efficient producers would go out of business. But in the modern global economy, there are a variety of forces that inhibit natural demise. Institutions are reluctant to shut down and accept the loss of huge start-up costs. Government support for basic industries can guarantee survival beyond the natural life cycle of economic viability.

The impact of the globalization of economic competition has been profound and in some ways unexpected. At its simplest level, globalization has increased the intensity and nature of competition. In a world where supply exceeds demand, the competitive importance of productivity and prices is reduced; quality, variety, customization, convenience, and timely delivery of state-of-the-art products and services become the competitive edge. In global markets, demand fragments, requiring competitors to tailor products and services to local tastes and needs. In addition, the complexity of and distances involved in global markets require increased service functions in order to deliver products and services. The rule of thumb in global competition, to borrow a phrase from the environmentalists, is to "think globally and act locally."

Globalization also seems to have shattered the "product cycle," a self-perpetuating hand-me-down process of international economic development that has been in place for time in memory. Until recently, the logic of the product cycle was historically proven and difficult to challenge. According to this logic, global economic development began in the developed world, principally in the United States, where the markets were the wealthiest and largest, the labor force was the highest paid and most skilled, and the financial capital was the most readily available. The American market was the logical seedbed for the development of new technologies and products and, as a result, the place where products were first developed and sold. Eventually, in every product line, the genius of mass production reduced production systems to simple tricks requiring a small cadre of elite white-collar and technical workers who managed relatively unskilled labor and standardized technology. Once simplified, mature production systems were passed on to less developed nations that could use simple technologies in combination with cheaper and less skilled labor. In the meantime, the United States moved on to the next wave of new technologies and products. In this hand-me-down system, the developed and underdeveloped nations of the world moved in lockstep up the development ladder. A rising tide in the developed world eventually raised all boats worldwide and did so without disrupting American superiority in the economic pecking order.

This comfortable cycle has broken down under the weight of the new economic reality. Development has made human and financial capital more available outside the United States, and markets outside the United States have accrued sufficient wealth to drive new product demand. Further, new global wealth, in combination with new communication, transport, and information technologies, has reduced the scale advantages of the American domestic market. The Japanese market is now almost half the size of the American market and growing. As economic integration proceeds in Europe, market size, buying power, and per capita income there and in the United States are becoming roughly equivalent (Dertouzos, Lester, and Solow, 1989, p. 25). In addition, new technologies and the dismantling of trade barriers have made the size of domestic markets less important. The Japanese, for instance, sell six times as many video cassette recorders (VCRs) around the world as they sell at home.

The most profound assault on the international product cycle has come from a general breakdown in its sequential nature. Today, the nation that develops a new idea may not profit from it before handing it down to a lesser economic power. Technology is footloose. The quality of the indigenous human capital is increasingly equal worldwide. As a result, nations can step into the product cycle at any given point. Indeed, it is often best to let others bear the cost of development and to focus resources on subsequent phases of the product cycle. There is pride in invention, but there is money in developing products, making small improvements in efficiency and quality, and developing new applications for existing technologies, products, and services (Teece, 1987; Ergas, 1987).

Globalization has been a mixed blessing for Americans. In a robust global market, the possibilities for economic expansion are impressive. The potential demand for goods and services in the world economy is vastly greater than current production levels. For instance, we now have one car for every 1.5 Americans, but in China, there is one car for every 2,122 citizens (U.S. Department of Commerce, 1989b). At the same time, globalization has helped change competitive standards in ways that do not play exclusively to our strengths. Productivity and the price reductions it brings are necessary, but not sufficient, for successful competition in global markets. Our scale advantages are eroding as Europe and Asia become more cohesive market spheres. In addition, the Europeans and Japanese have more experience than we do with the flexible production systems necessary to succeed in the highly fragmented global marketplace.

In the final analysis, however, we have no choice but to embrace the complex competitive standards of the global market and to devise a new set of rules and procedures to stabilize world trade. Our domestic markets are no longer large enough to satisfy our productive capabilities, and the extension of economic activity into the global market is necessary if we are to continue to increase our own standard of living. Moreover, if we are allowed access to foreign markets, we cannot deny others access to ours.

THE DIVERSIFICATION OF TASTE

Plain vanilla isn't good enough any more. Variety and customization of goods and services have become key competitive principles. Consumers' tastes have diversified because of a flammable mix of economics and demography at home and abroad. Increasing economic wealth contributes to diversity in demand in two ways. First, it changes what people want. As people get richer, a smaller share of their income goes for the basics of food, clothing, and shelter, and they begin demanding variety, quality, tailoring, convenience, and state-of-the-art products and services. They also want more intangibles. For example, they can afford to let environmental, health, and nutritional concerns influence their purchasing decisions.

Second, growing wealth gives economic voice to underlying ethnic, geographic, cultural, religious, and gender differences that were there all along. No nation, with the possible exception of the Soviet Union, is more diverse than the United States. Moreover, our diversity in taste is increasing. Demographic changes at home have resulted in a more complex domestic market. The aging baby boom continues to create fresh waves of new demands in its path and leave deflated markets in its wake. The American family has decreased in size, and increased in diversity. Also, enormous increases in wealth and life expectancy have resulted in new markets to serve older Americans (Kochan, Mitchell, and Dyer, 1982, pp. 4-5). The globalization of economic activity has also been a major external force in the diversification of tastes. There are many neighborhoods in the global village.

THE IMPORTANCE OF TIME

In general, although Americans have more money, they have less time to spend it. Americans, especially American women, are busier than ever (see Table 2). Although men are working a little less, women are working a lot more, and both men and women are spending more time commuting. Indeed, Americans and Australians have the longest commutes in the world. Sixty-four percent of Americans commute more than fifteen minutes to work (U.S. Congress, 1988, p. 69). Americans also enjoy fewer national holidays and have less access to paid leave than the citizens of most other modern nations (U.S. Congress, 1988, p. 70). Men are doing about an hour more housework per week now than in the mid-1970s, but women are doing almost four hours less housework per week. Both men and women are spending a little less time with their children and less time eating at home. Men have lost a little more than two hours free time per week and women more than three.

Women are working two shifts: the first on the job and the second at home (Hochschild and Machung, 1989).

The increasing scarcity of consumer time has had an enormous impact on competition for consumers' dollars and loyalty. Busy people have neither time nor patience for shoddy products or second-rate services. They want products and services tailored to their needs. They want ready information on the range of offerings, and will be loyal to institutions that consistently provide state-of-the-art quality or show where to get it. Above all, busy people want products and services that can be consumed conveniently.

TABLE 2

Change in Weekly Time Budgets of Men and Women Between 1975 and 1985

Activity	Men	Women	Average
Contracted Time	+18 minutes	+6 hours 48 minutes	+3 hours 30 minutes
Work	-24 minutes	+5 hours 54 minutes	+2 hours 42 minutes
Travel to Work	+42 minutes	+54 minutes	+48 minutes
Committed Time	+1 hour	-4 hours 30 minutes	-1 hour 42 minutes
Housework	+1 hour 18 minutes	-3 hours 54 minutes	-1 hour 18 minutes
Child Care	-12 minutes	-36 minutes	-24 minutes
Shopping	+6 minutes	No change	+6 minutes
Family Travel	-12 minutes	No change	-6 minutes
Personal Time	+36 minutes	+1 hour	+48 minutes
Eating at Home	-18 minutes	-48 minutes	-30 minutes
Eating Out	-42 minutes	+6 minutes	-18 minutes
Personal Care	+1 hour 36 minutes	+1 hour 42 minutes	+1 hour 36 minutes
Free Time	-2 hours 6 minutes	-3 hours 18 minutes	-2 hours 42 minutes
Education	-24 minutes	-6 minutes	-18 minutes
Volunteer Organizations	No change	-42 minutes	-24 minutes
Social Activities	-1 hour 24 minutes	-2 hours 18 minutes	-1 hour 48 minutes
Recreation	+18 minutes	-24 minutes	-6 minutes
Electronic Media	-1 hour 12 minutes	-18 minutes	-42 minutes
Other Media	No change	+18 minutes	+6 minutes
Leisure Travel	+36 minutes	+12 minutes	+24 minutes

How to Read This Table: In 1985, men were working 24 minutes less and women were working 5 hours and 54 minutes more than in 1975. Both men and women were spending more time traveling to work in 1985 than they did in 1975. In general, Americans, especially women, were spending more time in work-related activities.
SOURCE: (Robinson, 1986, p. 34).

THE COMMERCIALIZATION OF HOMEMAKING AND PERSONAL CARE

The scarcity of time has encouraged the development of markets for time-sensitive products and services. Americans are interested in buying goods and services that help them work at home more efficiently, and they are willing to buy goods and labor to do the chores they would otherwise do themselves. More and more of the work traditionally done off the job is being commercialized. The commercialization of homemaking, recreation, and personal care stems in part from the new work roles of women and changes in the structure of the American family. Child care, cleaning, care for the elderly, and other domestic activities were once largely foisted on women in the context of the traditional family. Increased opportunities for women, growing financial pressures, and the disappearance of the traditional American family suggest that the commercialization of homemaking and personal care will continue to be an important engine of market changes for decades to come.

This kind of commercialization inevitably expands market standards beyond price competition. For example, price is not the only criterion for choosing how to care for our loved ones, young or old. We want quality, choice, and services tailored to our individual needs. We may not have the time or expertise for home cooking, but we still want varied, high-quality, convenient meals. We may be too busy to teach our children, but we demand high-quality, customized education for them.

EXPANDING CONSUMER PARTICIPATION IN PRODUCTION AND SERVICE DELIVERY

A distinctive feature of the new product and service markets is the extent of consumer participation. Consumer participation has always been the hallmark of service delivery: The patient needs to interact with the doctor to formulate a diagnosis; the diner needs to work with the waiter to order the food; the potential claimant has to work with the insurance salesperson to pick the right policy; and the novice needs to work with the dance instructor to learn the right step.

Customer participation is nothing new in manufacturing, either. Traditionally, makers of household gadgets, products used for home-based entertainment, and recreational equipment have expanded consumption by creating hardware that required unpaid consumer labor to produce the final service or goods. The number of commercial laundries, for instance, was dramatically reduced with the introduction of mechanical washers and dryers that combined user-friendly technology with consumer labor.

But although consumer participation in production and service delivery is not new, now there is more of it. Both technical and organizational changes have facilitated this expansion. New user-friendly machinery can harness technology for the user's purposes through flexible software. Customer-focused organizational structures increase the ability of producers to tailor products by involving customers in production or service delivery.

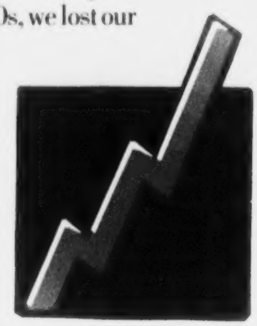
Consumer participation helps institutions meet new market standards. For example, computer-based technologies can allow customers to participate in designing goods and services tailored to their individual needs and preferences. Examples range from the growing proportion of shorter and more tailored production runs in manufacturing to the design of houses and insurance packages. The increased involvement of customers in the use of goods and services can have the same effect. For example, the teller machine provides convenience and allows the consumer to customize services; the VCR is more convenient than the movie theater or television and allows more variety; self-service at the gas pump is convenient; and the salad bar varies and customizes a restaurant's menu.

TECHNOLOGY

The new market standards would not have been possible without an equally new role for technology. In traditional manufacturing, for instance, machinery was hard wired for narrow purposes. Each machine made a piece of the product, and a new product or a new piece required a new machine. The fragmented markets faced by the Japanese and Europeans, however, required a more flexible use of existing technologies. In the 1950s, the Europeans and Japanese developed work processes for using narrow-purpose and relatively inflexible equipment more fluidly. For instance, they learned to use team-based production to reset machines or roll different machines in and out of the assembly line quickly to reduce downtime when changing from one version of a product to the next (Womack, 1989; Piore and Sabel, 1984).

Eventually, information-based technologies allowed employers to locate flexibility in the technology itself, as well as in the work processes for using the technology. With flexible software, a few keystrokes at a control board can reprogram machinery and work processes. The computer has brought a whole new level of built-in flexibility and precision in production and service delivery. Those who have exploited fully the flexible new technology, by using it in conjunction with equally flexible workforces and organizational formats, have raised the level of competition and increased the range of competitive standards. For example, the computer's precision allows employers to raise the ante on productivity and quality standards. The computer saves time by allowing workers to make changes with a few keystrokes rather than reconfiguring whole production systems or work processes. The new technology also provides convenience. User-friendly software makes technical complexity as invisible to most customers and workers as the carburetor is to most drivers of cars.

Productivity and Beyond: Measuring America Against the New Market Standards



It takes more than productivity and low prices to win the competitive race. American productivity in computer chips, for instance, has been as good as or better than that of our competitors, yet by the late 1970s, we lost our market share because our chips were not as reliable as those produced in Japan (Clausing, 1989, p. 7). Similarly, our productivity in textiles is world class, and our German and Italian competitors have higher wage costs, more aggressive unions, and less government protection. But we continue to lose market share to both the Germans and the Italians (Berger, 1989). In short, although productivity is still primary in the mix of competitive standards in the new economy, it has been joined by a new set of standards. None of the forces that have given rise to the new competitive standards shows any sign of relenting. The inevitable conclusion is that our economic status among the community of nations will depend on our ability to meet these new standards.

PRODUCTIVITY

The American productivity rate is still the world standard (see Tables 3 and 4). Yet the rate of increase in productivity is much greater among our competitors than in the United States, and other nations will catch up and pass us if present trends continue (see Tables 3, 4, and 5). Evidence suggests that the United States is already losing the productivity race to Japan in some industries, such as chemicals, steel and other primary metals, electrical machinery, and transportation equipment (Sadler, 1977).

America's recent productivity problems are well-known. Our rate of productivity boomed between 1948 and 1965, averaging 3.5 percent. The rate slowed to 2.0 percent between 1965 and 1973, however, before collapsing and turning negative in 1974 (-2.1 percent). After 1974, the rate barely held its own, registering a disappointing average increase of 1.1 percent until 1977, when the productivity increase in the United States fell below 1.0 percent. Productivity improvement in the 1980s has remained well below the long term average of 2.0 percent.

The American productivity story is not all gloom, though. We need to improve our productivity by only 1.2 percent a year in order to improve our standard of living by about 1.5 percent per year, a rate sufficient to afford our accustomed lifestyle. A 1.2 percent increase in productivity would be a difficult but not unattainable target (Freedman, 1989).

The best productivity news has come in manufacturing, where we need productivity most to maintain our competitive position in the global economy. Manufacturing productivity improvement collapsed in the early 1970s but has made a remarkable comeback in the 1980s, growing at a rate above 3 percent since 1982 (Morris, 1989, p. 56). This rate is roughly equivalent to our best productivity performance in manufacturing and almost twice the overall productivity trend in the postwar era. Although the Japanese, Germans, Swedes, French, British, and Italians are still running faster than we are, we appear to have finally reacted to the chase (Fullerton, 1989, p. 3). Moreover, although most industrialized nations have experienced a productivity slowdown since 1973, the United States and the United Kingdom are

TABLE 3

The Productivity of Other Nations as a Percentage of American Productivity, 1950–1989

Country	1950	1960	1970	1980	1989
United States	100.0	100.0	100.0	100.0	100.0
Canada	69.5	72.0	78.1	92.1	94.2
Norway	49.9	56.7	61.6	79.0	81.4
Sweden	59.1	66.6	76.3	76.7	75.1
Japan	16.1	28.8	55.8	66.1	74.9
Germany	36.0	61.1	67.9	74.3	72.8
France	44.4	54.4	65.8	73.1	70.1
Denmark	51.5	62.1	69.1	70.6	69.2
United Kingdom	60.4	66.5	64.9	66.2	68.6
Belgium	46.4	50.8	60.9	69.9	68.0
Italy	31.7	44.9	57.3	67.1	67.3
Netherlands	53.4	61.4	69.4	72.4	66.6
Austria	31.4	47.0	55.0	66.2	65.0
Korea	Not Available	9.5	12.9	20.9	34.4

How to Read This Table: American productivity is shown as 100.0 percent in each year, and each nation's productivity is expressed as a percentage of the American productivity rate. In general, the table shows that although the United States is still the world's overall productivity leader, other nations are closing the gap. For instance, in 1950, the Canadian productivity rate was 69.5 percent as high as the U.S. productivity rate. By 1989, Canadian productivity had risen to 94.2 percent of American productivity. Japan's productivity rate was only 16.1 percent of the American productivity rate in 1950 and had risen to 74.9 percent of U.S. productivity by 1989. *SOURCE: (U.S. Department of Labor, Bureau of Labor Statistics, April 1990, unpublished data).*

TABLE 4

Value of Output Per Person in the United States and Other Nations, 1950–1989

Country	1950	1960	1970	1980	1989
United States	$ 9,972	$11,559	$14,777	$17,369	$20,891
Canada	$ 6,926	$ 8,322	$11,545	$15,999	$19,679
Japan	$ 1,605	$ 3,325	$ 8,238	$11,483	$15,655
Germany	$ 3,593	$ 7,066	$10,037	$12,908	$15,211
France	$ 4,428	$ 6,290	$ 9,729	$12,689	$14,646
Korea	Not Available	$ 1,101	$ 1,912	$ 3,631	$ 7,184

How to Read This Table: The dollar value of economic output per person is shown for each country. For instance, if we had divided our total output evenly among all Americans in 1950, each of us would have gotten $9,972 worth of goods and services. By 1989, our total output was sufficient to afford each American $20,891 worth of goods and services. In general, although the table demonstrates that we are still the world's wealthiest people, other nations are catching up. *SOURCE: (U.S. Department of Labor, Bureau of Labor Statistics, April 1990, unpublished data).*

the only two nations that have had a productivity turnaround and matched their pre-1973 performance (Fullerton, 1989, p. 3).

At a minimum, even a small acceleration will make us all the more difficult to catch. Indeed, should our rate of increase in productivity continue to improve, our competitors will be hard pressed to catch up, given our current lead in the race. If we are to hold the lead, we will have to continue to improve our performance in manufacturing, but even more will depend on our ability to jump-start the stalled productivity engine elsewhere.

The principal drag on the nation's overall productivity comes from the service sector. For instance, if white-collar workers in the service sector had been as productive as white-collar workers in manufacturing, the overall productivity rate would have risen by more than an additional 0.5 percent in the 1980s, bringing the overall productivity rate above 2.0 percent—a rate consistent with our world-class pace prior to 1973 (Roach, 1989).

Demographic and technological trends already in place could help continue the boom in manufacturing productivity and extend it to other industries. The size of the workforce will decline over the foreseeable future, especially at entry level. This trend represents a dramatic turnaround from conditions in the 1960s and 1970s, when the baby boom encouraged employers to substitute relatively cheap labor for skill and technology. This practice made America the world's best job creation machine in the post-World War II era but probably led to some significant share of this nation's mysterious productivity decline after 1973 (Morris, 1989). As we look to the future, however, the continuing decline in the overall size of the workforce will boost investments in human and machine capital. A smaller workforce will have to be more skilled and utilize more technology to maintain output. The result will be an increase in output per worker, which means increased productivity. The demographic news at entry level is not all good, however, because a growing share of our entry level workers will come from populations in whom our human capital investments have been woefully inadequate. As a result, the cost of developing workers with necessary skills will increase.

TABLE 5

Percentage Increase in Productivity, 1950–1989

Country	Percentage Productivity Increased
Japan	6.0
Korea	5.7
Italy	3.9
Austria	3.8
Germany	3.8
Norway	3.2
France	3.1
Belgium	2.9
Canada	2.7
Denmark	2.7
Netherlands	2.5
Sweden	2.5
United Kingdom	2.2
United States	1.9

How to Read This Table: The rate of increase in overall economic output is shown for each nation. For instance, between 1950 and 1989, overall American productivity increased by 1.9 percent a year on average. Over the same period, Japanese productivity increased by 6.0 percent a year on average. As a result, although we are still the productivity leader, the Japanese and other nations are catching up. *SOURCE: (U.S. Department of Labor, Bureau of Labor Statistics: Bulletin No. 89-32, 1990).*

The best demographic news comes at midcareer. After decades of expensive preparation, the baby boom is finally on the job. We have already paid the productivity price of integrating these workers into the workplace and can now look forward to thirty or forty years of continuous productivity improvements as they learn formally and informally at work. Available evidence suggests that individual performance does not peak until workers reach their late fifties. The average age of the American workforce will not reach the fifties until 2050. As a result, we can expect productivity improvements until the middle of the next century, when the workforce will start getting younger again.

In addition, as the baby boom ages and the demographic center of gravity in the United States shifts toward middle age, more financial capital will become available for investment in both human and machine capital. The baby boomers are entering their prime saving years. Moreover, because virtually all baby boomers who can afford houses have already bought them, less capital will be absorbed in the mammoth housing sector and more capital will be available for investments in machines and people. Demographically driven housing demand is likely to fall off by as much as 30 percent. Already the inventory of homes available for sale has risen by a third since 1972 (Morris, 1989).

Trends in technology are also favorable for the nation's future productivity performance. The application of profound technical changes usually takes a long time. Electricity, for instance, was generally available by 1860 but was not commonly used in American homes and businesses until the 1920s. And although electricity declined in price by more than 400 percent over the same period, the sale of steam engines did not peak until the early decades of the twentieth century (Liebergott, 1984). The flexible technologies of the new economy, especially information technologies, are in their infancy. We are still in the most primitive phases of applying these technologies at home and at work.

QUALITY

Quality appears to be primary among the new competitive standards and is rapidly becoming the bully of the block. Remarkably, in 1989, when the nation established its first major award for economic excellence, it was an award for quality, not productivity. By act of Congress, and with the enthusiastic support of American industry, the award was called the Malcolm Baldrige National Quality Award (named for the former Secretary of Commerce) (Segalla, 1989).

Quality is measurable from two points of view. One set of quality measures looks at the product or service from the inside out, a point of view usually adopted by the maker of the product or deliverer of the service. Another way to look at quality is from the outside in, a point of view that emphasizes the consumer's perspective.

Inside-out measures are usually concerned with built-in quality, which is achieved in the design and production of a product or the design and delivery of a service. Built-in quality in manufacturing, for example, is usually measurable by an engineering standard such as the number of defects or mistakes per quantity of product. In services, built-in quality is usually measured by the extent to which state-of-the-art processes, personnel, or equipment are used. A medical exam, for instance, meets quality standards if delivered by certified personnel who follow recommended procedures.

The complementary outside-in view of quality presumes the proof of the pudding is in the tasting, and relies on the consumer's estimation of quality. Measures of this more external standard tend to assess the performance of the final product or the effects of the service. Automobile performance standards and the effects of heart transplants on longevity are cases in point. Performance standards, especially measures of customer satisfaction, are often more subjective than measures of built-in, or internal, quality.

American performance on quality is mixed. In automotive manufacturing, for instance, the number of defects per American-made vehicle is decreasing dramatically. The built-in quality of our cars is currently on a par with that of European cars, but we still manufacture twice as many defects per vehicle as the Japanese (Womack, 1989, p. 36). Independent auto watchers J. D. Power and Associates reported, in a 1986 survey of customer satisfaction, that the United States scored 94 points; the Europeans, 106; and the Japanese, 119. In 1989, the United States scored 112; the Europeans, 111; and the Japanese scored highest at 130 (The Power Report, 1989, p. 4). In the consumers' estimation, we have overtaken the European auto manufacturers by a hair's breadth, but the Japanese are still the market standard for quality.

Data on quality for textiles, computer chips, steel, and many other American industries are mixed, and data for consumer electronics, chemicals, and machine tools are downright disappointing (Dertouzos, Lester, and Solow, 1989).

There is still such a thing as American quality. America sets the world's quality standard for other industries, such as aerospace, aircraft, large computers, appliances, and health care. Indeed, General Electric, Whirlpool, Maytag, and other American appliance manufacturers initiated quality improvements before being challenged by overseas competitors. Since 1980, these manufacturers have cut defect rates by more than three-quarters and customer service and warranty claims by half (Dumaine, 1989, p. 140).

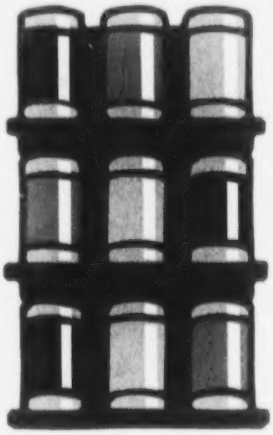
There have also been individual turnarounds on quality in every industry. NUMMI, the GM-Toyota plant in Fremont, California, averages only 0.55 defects per car, a level equal to Japanese production quality and almost twice as good as the American average (Womack, 1989, p. 39). Motorola, one of the first three recipients of the Malcolm Baldrige National Quality Award in 1988, lowered its defect rate from no more than 5,000 defects per 1,000,000 chips to 500 defects and then to 3.4 defects per 1,000,000 chips (Galvin, 1988). Xerox, one of two Baldrige award winners in 1989, installed a companywide quality standard and overtook the Japanese lead in the photo copier market. And Harley-Davidson, which reached a manufacturing defect rate of 50 percent in 1972, has since cut defects to 1 percent of production (Reid, 1990).

VARIETY

The standardized offerings of mass production have given way to an explosion of choices. For example—

- Americans now choose among 572 different models of cars, vans, and trucks, compared with just 408 in 1980. In the mid-1980s, vehicle manufacturers counted seven distinct market segments altogether for cars and trucks. As we enter the 1990s, manufacturers identify nineteen distinct market segments for cars and eleven for trucks (Ingrassia and Patterson, 1989).

- Consumer banking has expanded from six basic services in the mid-1970s to more than one hundred today (Noyelle, 1989).
- Retail specialty chains like Toys R Us, The Gap, The Limited, Circuit City, and Esprit have cut into the market shares of major department stores by offering more specialty items. New specialty stores are emerging daily for everything from telephones to Christmas decorations, kites, and balloons.
- Between 1979 and 1989, the number of items carried on supermarket shelves rose from 12,000 to 24,000 (Noyelle, 1989). The number of breakfast cereal brand names went from 152 to 271. The number of soup brand names increased from 55 to 83.



The explosion in variety comes from the same forces that have set the new quality standard. People can afford variety. The fragmented global market demands it. New flexible technologies allow variety at mass production prices. The saturation of domestic and global markets also encourages variety. Once large-scale markets for standardized products mature, variety can be an effective way to gain market share. This pattern is evident in the recent histories of the retail banking, communications, chemicals, and steel industries.

In retail banking, institutions competed throughout the 1950s and 1960s on the basis of their ability to sell checking and savings accounts through a growing network of branch offices. In the 1950s, only 20 percent to 30 percent of American, German, and French families had checking or savings accounts. As the 1980s approached, almost 90 percent of these families had such accounts. Competitive pressures eventually expanded banking services, revitalizing the competition and ultimately transforming the banking business into the financial services industry (Noyelle, 1988b).

In the 1950s and 1960s, the communications industry was the telephone business. Saturated by the mid-1970s, this business escaped the declining prospects of maturity by expanding products and services to include data transmission and new communications services.

By the late 1960s, the chemical industry had matured. In addition, the available technology had diffused throughout the world, greatly increasing world capacity for chemical production. The net result was chronic overcapacity. There were generally from 20 percent to 30 percent more commodity chemicals available than anyone wanted to buy. Moreover, as new capacity came on line, prices dropped faster than costs, a common phenomenon in mature markets for basic commodities (Wei, 1989). In response, the industry has gone through a worldwide restructuring, deemphasizing commodity chemicals and diversifying into a greater variety of more complex products produced in smaller quantities (Wei, 1989).

The same process has occurred in steel, resulting in a shift from large, integrated producers to minimills and specialty steel producers. Growing capacity in world production has long since resulted in a glut of steel on the market. Foreign producers have been able to produce steel more cheaply than we have, and in the past twenty-five years, the American steelmakers' share of domestic steel markets has fallen from 95 percent to 60 percent (Kendrick, 1988, p. 18). American steelmakers, no longer the low-cost producers of the basic commodity, have had to shift to a strategy emphasizing the new competitive standards, including variety. The most obvious evidence of this shift has been the growing importance of specialty steel and minimills and the relative decline in markets for large- scale producers. By 1988, specialty steel represented only 5 percent of U.S. production but a much higher proportion of total revenues; since 1980, the number of minimills has doubled from thirty to sixty (Kendrick, 1988, pp. 18-19). The minimills had captured 13 percent of the market for carbon steel by 1980 and 21 percent by 1985; they are projected to hold a market share of 40 percent by the year 2000 (Flemings, 1989).

CUSTOMIZATION

In the family of competitive standards, customization is first-cousin to variety. Busy people with more buying power want more choices in products and services to meet their individual needs. At a minimum, this demand results in increased variety designed to satisfy market segments, and in a growing number of industries, the urge to move from a one-size-fits-all approach to a more tailored market strategy is resulting in customization. As human and machine capital becomes more flexible, the relationship between scale and production costs weakens, and fewer units of output are necessary to realize scale economies. The ability to customize represents the victory of flexibility over scale. Ultimate flexibility is realized when the cost - effective scale of production reduces to one.

At present, many employers are trying to marry variety and customization. A bank, for instance, provides a variety of financial services and with the assistance of information technology can develop a customized package of these services for the individual.

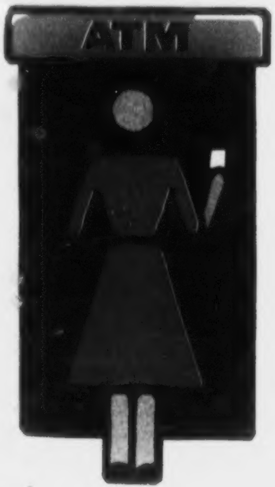
The textile and apparel industry provides another case in point. Textile production, especially in doubleknit fabric, was saturated in the early 1970s. The apparel market was saturated at about the same time, and many garments were left on the rack as demand declined further with the oil price increases after 1972. Many manufacturers turned to shorter production runs of fiber, garments of higher quality and more variety, and customization. At Milliken, textile lot sizes were reduced from an average of 20,000 yards of cloth to 4,000. Dan River reduced lot sizes from 12,000 yards to special runs as low as 1,800 yards while offering more than 2,000 varieties of fabric (Berger, 1989, p. 55). At Melbo Apparel in Japan, lot sizes for suits were reduced to one. A similar trend in Germany and northern Italy suggests that the apparel industry may have come full circle from tailoring prior to the industrial revolution in the 1700s, to mass production after 1800, and back to tailoring in the new economy, emerging in the closing decade of the 1900s. Both the Japanese and the Italians are heading toward a system in which an individual order specifying fabric, style, and size will be filled in a few weeks by using highly responsive, electronically driven networks of retailers and apparel, textile, and fiber manufacturers (U.S. Congress, 1988, pp. 46-47, 236-240; Piore and Sabel, 1984, pp. 213-216; Berger, 1989, p. 53).

CONVENIENCE

Busy people crave convenience. More and more consumers can afford it. And flexible technologies can provide it. In the complex global economy, delivering the product or service conveniently can be the competitive edge that differentiates one company from another.

There are three kinds of convenience: built-in convenience, convenient delivery, and high-quality customer relations. Built-in convenience comes with effective product designs and exploitation of user-friendly technologies and software. Remote controls, bank teller machines, automated self-service machines, home entertainment centers, car phones, and computer dating networks are examples.

Convenient delivery is more important as domestic markets fragment and competition goes global. The growth in the number of "convenience stores" is one bit of evidence. There are almost 8,000 7-Elevens in the United States and another 4,000 overseas, with an average of 1,000 customers daily. One-stop shopping is on the rise. Drive-in islands that offer gas, convenience shopping, and teller machines are appearing everywhere. Supermarkets are currently devoting 25 percent of their space to specialty departments such as self-service delis, pharmacies, and bakeries. "Hypermarkets"—which are essentially malls without walls—are the latest in convenient delivery in retail. They range in size from 200,000 to 250,000 square feet and carry upwards of 70,000 items.



Convenience in the form of successful customer relations can be a powerful selling tool and competitive edge. It costs five times more to get a new customer than it does to keep an old one. Dissatisfied customers will not buy again, and each will relate his or her unhappiness to roughly ten other people (Desatnick, 1987, p. 4). What's more, one survey found that for every customer complaint, another twenty-six customers have the same problem, and that anywhere from 65 percent to 95 percent of those noncomplainers will eventually stop doing business with the offending company.

Losing customers is serious. In *Service America!*, Albrecht and Zemke (1985) cite some generally accepted statistics on the value of customer loyalty. For instance, in the auto industry, a loyal customer is worth $140,000 over a lifetime of car buying. In appliances, a loyal customer is worth $2,800 over a twenty-year period. At the local supermarket, a loyal customer is worth $4,400 a year (Desatnick, 1987).

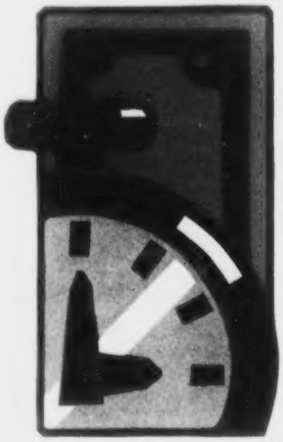
A survey of "why customers quit" found the following:

- 3 percent move away,
- 5 percent develop personal loyalties to other businesses,
- 9 percent choose other suppliers' more competitive products,
- 14 percent are dissatisfied with the product or service, and
- 68 percent perceive that they were treated badly or with indifference (LeBoeuf, 1987).

By all reports, the expectations for service are increasing, and Americans are expressing a growing dissatisfaction with the customer service they get. A Conference Board survey of 6,000 households concluded that Americans were reasonably satisfied with products but pervasively dissatisfied with service quality. *The Yankelovitch Monitor* surveyed 2,500 Americans about their satisfaction with customer service and found that respondents estimated only airline service had improved over time (Denton, 1989, p. 1). But a closer look at airline customer service does not bear out *Yankelovitch's* good news. Zemke reports that, in 1987, the U.S. Department of Transportation received more than 44,000 complaints from airline passengers, an increase of 25 percent over 1986. In 1987, only 66 percent of airline flights arrived on time and airlines lost 11 out of every 1,000 pieces of luggage (Zemke, 1989).

TIMELINESS

The early bird will win market share in the new economy because time is money. According to one study of high-tech markets, products that come to market on budget but six months late will earn 33 percent less profit over five years than products that come out on time but are 50 percent over budget (Nasar, 1987).



Institutions compete in several successive races against the clock:

- First event: Develop a major innovation, whether a technology, a product, or a new work process.
- Second race: Move the innovation off the drawing board and into the hands of consumers.
- Third event: Race up the learning curve to improve the innovation by increasing efficiency, improving quality, or developing new applications.
- Final race: Use the knowledge accumulated in the race up the learning curve to make a breakthrough to another major innovation. This race occurs after institutions have wrung all possible incremental improvements and new applications out of the original innovation.

A single employer or nation rarely wins in all these races. In the nineteenth century and first half of the twentieth century, the United States became a world-class economic power by borrowing ideas from abroad. We were not the best at invention, but we were first in the race to get these borrowed ideas off the drawing board and into the hands of customers. After World War II, however, Americans became the wellspring of invention. The United States ended up with the lion's share of the world's intellectual, financial, and physical capital. These resources in combination with our postwar leadership in defense and space-related research ensured that we would be first to develop most large-scale innovations.

Since the end of World War II, the United States has been the global leader at invention, but our relatively rigid mass production techniques and organizational structures are holding us back in the race to commercialize, improve, and multiply the products of invention. Additional disadvantages are our overly specialized human and machine capital and inattention to the development of human capital and organizational learning at the point of production and service delivery, and at the interface with the customer, where inventions are turned into commercial successes.

Evidence of our inability to beat the clock has been accumulating for some time. For instance—

- Japanese auto manufacturers renew their designs every four years, whereas Americans attempt to make a basic design last up to ten years. Because the Japanese auto makers develop and design faster, they introduce a new line of products every seven years, but Americans wait as long as fifteen years to turn over a basic product line (Womack, 1989, pp. 28-29).
- Dies, the metal molds that are used to stamp or cut metal to specific shapes, play a key role in changing automobile models. The ability to set new dies and to change dies in production quickly is critical to variety and customization. It takes the auto maker in Japan twelve months to set new dies, compared with twenty-three months in the United States (Dertouzos, Lester, and Solow, 1989, p. 70). On the factory floor, die changes that can take as long as eight to twenty-four hours in American auto plants can take as little as five minutes in Japanese plants (Dertouzos, Lester, and Solow, 1989, p. 19).
- In the steel industry, it takes four to five years to design and build a new blast furnace in the United States, compared with three years in Japan and two years in Korea (Dertouzos, Lester, and Solow, 1989, p. 15).
- In the apparel industry, it takes most American institutions up to sixty-six weeks to get from fiber to finished garment. Many European and Asian companies reach the customer in twenty-three weeks, and at least one Japanese manufacturer hopes to reduce the time to a few weeks (U.S. Congress, 1988; Berger, 1989, pp. 53, 62).

The news on American employers' ability to outrun competitors is not all bad. Americans have led in all four of the competitive races in some industries, such as aircraft, computers, and appliances, throughout the postwar era. In addition, the United States boasts examples of speedy institutions in every industry: Milliken in textiles; WalMart in retail; Motorola, Xerox, and Hewlitt Packard in high-tech manufacturing; and Harley-Davidson in low-tech manufacturing. Even in industries where whole companies are not model performers, there are always individual plants, like NUMMI in auto manufacturing, that lead the pack.

The New Competitive Framework

The new competitive standards are birds of a feather. That is, they are mutually reinforcing and develop simultaneously. They are understood best as a framework in which each standard makes sense only in the context of the others. Individual employers who begin by emphasizing one of these standards usually end up embracing them all because each standard overlaps and leads on to the next. In the final analysis, the distinction among the standards is in part semantic. Each is integrally connected to the others in a flexible and organic whole.

ROBUST PRODUCTIVITY

Productivity is pursued differently in the new economy than in the old. In the organizations of the old economy, white-collar and technical elites increase productivity principally by rationalizing organizations, mechanizing work processes, and reducing personnel costs by using fewer or cheaper employees. The essential goal of the productivity strategy is greater efficiency—more output for less cost. The main target for cost cutting is personnel costs, because they represent the lion's share of costs in every organization. By automating work processes and instituting rigorous organizational designs, employers in the old economy use cheaper labor by reducing skill requirements, and realize even more substantial savings by reducing the size of the workforce.

The old-time religion of productivity with a singleminded focus on cost reduction does not work in the new economy. Highly rationalized bureaucracies are too rigid to respond to the fast pace of change that characterizes the new competitive environment. The organizations of the old economy hoard authority and resources at the top. The presumption is that general access to authority and resources will result in profligacy and waste. Yet, in the new economy, access to authority and resources is required at the point of production and service delivery and at the interface with the customer if the organization is to provide quality, variety, customization, convenience, and timely innovations. Moreover, authority and access to resources are required down the line in order to encourage full utilization of the new flexible information and communications technologies at the core of the new economy.

Increasing productivity by reducing costs results in lean organizations, narrow-purpose technologies, and unskilled workforces that are cheap but too inflexible and anemic to respond to the new, broader set of competitive requirements. The new economy requires organizations, technologies, and workforces that are flexible and robust. In the old economy, organizations, technologies, and workforces are targets for cost reduction—in the new economy, they are resources to be developed in order to add value.

FLEXIBLE VOLUMES

A basic tenet of the mass production economy was that increased standardization and higher volumes drove prices down, whereas greater variety and lower volumes drove prices up. One rule of thumb said that cutting variety by half raised productivity by 30 percent and cut costs by roughly 15 percent; doubling the volume of a standardized good or service decreased cost per unit of output from 15 percent to 25 percent (Stalk, 1988).

As competition heated up in the postwar era, high-volume production became a competitive box with no easy exit. Global production capabilities increased, volumes went up, and prices kept going down, reducing profit margins. American employers continued to retreat into high-margin markets, surrendering low-margin niches to newcomers. Narrow product lines and rigid production systems dedicated to fewer and fewer products also limited options for growth in product lines.

The Japanese and Europeans had different problems. Their domestic markets were small, leaving little room for high-volume production at home and forcing them to provide variety for diverse markets abroad. Only narrow, low-margin niches were left for high-volume products; the United States and other industrial leaders had left these niches behind because of tiny profit margins.

To resolve their competitive dilemma, the Japanese and Europeans eventually broke the link between scale and variety by making more flexible use of their human, machine, and organizational capital. For example, one U.S. producer of automobile components produces ten million parts per year and offers only eleven varieties of components. This company's Japanese competitor produces only three and a half million units per year but offers thirty-eight different varieties. More important, with one-third the scale and three times the variety, the Japanese producer has a labor productivity one and one-half times that of the U.S. company and produces at half the unit cost (Stalk, 1988, p. 44).

Ultimately, the pursuit of variety begets its closest cousin—customization. The distinction between these standards is a matter of degree. Variety becomes customization as a production or service institution becomes more flexible and products or services sold come close to being one of a kind.

SPEED

Variety and customization eventually encourage speed. The need to shift from product to product or to vary products without losing productivity forces a focus on speed. By way of contrast, rigid mass production systems require long lead times to refit human resources and machine technology to new products or services. The problem is that long lead times cost money, reduce responsiveness to markets, and force an excessive reliance on forecasts of demand, which are often wrong. Poor forecasts result in either excess inventory costs due to overproduction or losses due to underproduction. Bad forecasts lead to more planning, less risk taking, and even longer lead times and less accurate forecasts.

A focus on time increases productivity and saves money. In traditional manufacturing, products are being worked on only 0.05 percent to 2.5 percent of the time. Tighter production systems can result in enormous savings. For example—

- A just-in-time production system installed at Hewlitt Packard resulted in inventory reductions of more than 60 percent, reduced space requirements more than 30 percent, and lowered labor costs more than 20 percent (Clausing, 1989, p. 32).
- Harley-Davidson reduced the time it took to make a motorcycle from thirty days to three and cut production costs by more than 50 percent (Smith, 1987, p. 38).
- In 1982, Toyota could manufacture a car in two days but required another fifteen to twenty-five days to close a sale. The sales and distribution function was consuming 20 to 30 percent of the cost to the customer, an amount greater than the cost of manufacturing the car. By 1987, Toyota had reduced the distribution time to nine days, with a commensurate reduction in cost.
- In the U.S. apparel industry, on average, it takes more than sixty-five weeks to move from fiber to a finished product available to customers (Berger, 1989; U.S. Congress, 1988, p. 239). The material is actually being worked on for only fifteen of those weeks. One industry study found that the snail's pace of production and delivery resulted in a 25 percent increase in costs and losses:
    - — 6.4 percent in extra carrying costs to maintain inventory,
    - — 4.0 percent in losses because retailers did not have the product on hand, and
    - — 14.6 percent in losses because of forced markdowns due to late arrivals (Berger, 1989, p. 63).

Some companies have been able to shorten response time to twenty-one weeks, reducing the price of apparel by almost 13 percent (Berger, 1989, p. 62; U.S. Congress, 1988, p. 240). Industry experts tend to agree that there is no technical reason why response times cannot be reduced to a few weeks.

AFFORDABLE QUALITY

The quality standard has become the emblem of the new competitive framework. Experience teaches that pursuing quality invariably improves performance on a host of competitive standards. For instance, the customer's view of quality certainly includes the convenient and timely availability of a variety of state-of-the-art products and services tailored to the customer's needs. A high-quality car that works is a convenience to the customer. A tailored suit provides both quality and customization. Quality tends to improve as the state of the art advances in any line of goods or services. As a result, quality and timely delivery of state-of-the-art products and services are inseparable.

Most experts agree that the typical factory invests 20 percent to 25 percent of its operating budget in finding and fixing mistakes and another 5 percent of its budget doing recall work after mistakes have left the factory gates (Port, 1987, p. 132; Allaire and Rickard, 1989, pp. 22, 25). The experience of particular companies tends to verify the relationship between quality and productivity. For example, the Xerox quality program reduced production costs by 20 percent (Allaire and Rickard, 1989, p. 24). Harley-Davidson reduced the cost of reworking defects by 60 percent by focusing on quality manufacturing techniques (Port, 1987, p. 132). GM's Lansing assembly plant drove costs down by 21 percent with embedded quality procedures (Hampton, 1987, p. 139).

Thus, quality often is the best antidote for a productivity problem. Because most quality problems stem from design (Port, 1987, p. 132), improved design can mean big productivity gains:

- Experts claim that no more than 20 percent of quality problems result from production defects. The other 80 percent occur at the design stage of a product or service (Port, 1987, p. 132).
- More "robust" designs that allow high performance despite production errors have slashed performance defects at ITT by more than half and saved more than $60 million (Port, 1987, p. 135).
- Ford redesigned an instrument console for the 1987 Escort using only six parts, compared with the twenty-two parts in the original 1984 model. The effect was to reduce material costs by 39 percent, drive down labor costs by 83 percent, and improve the defect rate by 10 percent.

CUSTOMER FOCUS

In the final analysis, the pursuit of any of the new competitive standards ultimately translates into convenience for the customer. Providing variety and customization begets convenience because they offer choices that meet the specific needs of groups or individual customers. The pursuit of timeliness leads to convenience as well. Employers who try to build speed into their products and services inevitably end up closer to their customers, and these close ties are a fresh source of information on customers' needs and desires. Attention to speed also increases convenience because, for a busy consumer, convenience is largely a matter of time saved. Higher quality products and services are convenient because they work better. Every competitive victory in the new economy results in more convenience for the customer. For example—

- In the traditional mass production mode, shirts are broken down into component parts for manufacture; then components are brought together for final assembly. If a shirt factory requires a week to fill the average order and ten orders come in the same day, it will be ten weeks before the last order is filled. More advanced companies are organized into small units, each capable of making entire shirts, however. If there are ten such units in a factory, ten orders can be filled in one week. Indeed, some of each order can be shipped each day. In one company that used this strategy, productivity increased by 5 percent, individual shirts were available to customers in half a day, the share of defective shirts dropped from 2 percent to 0.2 percent, and space requirements for inventory and production were cut in half (Bailey, 1988c, p. 13). The big winner in the reorganization is the customer, who gets shirts cheaper, faster, and with fewer defects.

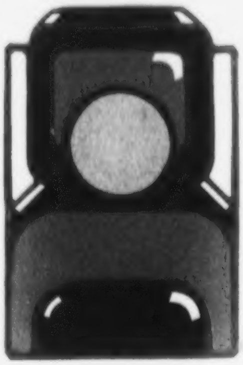
- The Aid Association for Lutherans replaced specialized functional departments in its insurance services with teams responsible for providing full service to individual regions. As a result, personnel costs were cut by 10 percent, and the overall number of cases handled increased by 10 percent. Overall productivity increased by 20 percent, and the time it took to process a case was reduced by 75 percent (Hoerr, 1988, pp. 64-72). The Aid Association insurance customers got their insurance cheaper, faster, and in packages customized for their individual needs.

TECHNOLOGY AND THE NEW ECONOMY

PART II

Humanity has a long-standing love-hate relationship with technology. Technology improves and extends our lives but, at the same time, manages to disrupt and even threaten our existence. Some of our discomfort with technology results from the fact that it has never been entirely clear whether people or machines are in the driver's seat.

Because technology plays many roles in the human drama, the alternative portrayals of technology as monstrous villain, hero, and agent of the ruling classes are all convincing. Technology is always there when we round up the usual suspects after some social or economic calamity, but it is just as often the hero that, preceded by bugle calls, arrives in the nick of time to extract humanity from some social or economic impasse. On balance, the optimistic depictions of technology have prevailed in the western hemisphere. Armed with the characteristic European and American faith in technical progress, the champions of technical change have persuaded us to rejoice in our technical victories over the natural world and the human condition and to accept our losses grudgingly.



People versus Machines

Historically, there have been three dominant perspectives on the role of technology in social and economic change. One gloomy perspective often espoused in the arts, theology, and philosophy pits humanity against the machine in a constant struggle for dominance and survival. This view portrays technology, the natural world, and the human condition (death) as a triumvirate of forces that must be overcome to allow the human ascent to some higher state.

The notion of a titanic struggle between humanity and the machine is a persistent theme in modern intellectual and cultural history. In the early days of industrialization, Ned Ludd and his roving bands asserted dominance over machines by smashing them (Garraty, 1979). Since then, the Luddites among us have tended to characterize the advance of technology as a Faustian pact with the devil: We receive material progress in exchange for a reduction in the quality of our private and working lives.

Those who subscribe to this view write the history of work as a tragedy in which work is dehumanized by mass production technology that constantly encroaches on human skill. As they see it, the mass production system breaks final products and services into their smallest components and then dissects the talents of whole persons into narrowly elementary skills that are combined with specialized technologies to produce these components. "Tools" that allow the artisan to embody human talent in final products or services become "machines" that subordinate the worker to the technology.

To make matters worse, institutional structures utilize top-down hierarchical authority to recombine fragmented skills and components into final products and services. The net effect is the sublimation of the whole person at work, a loss of human autonomy as technology advances, and a shift in the pace of work from the natural and human rhythms of farm and craft to the artificial cadence of the machine (Arendt, 1970; Piore and Sabel, 1984).

This titanic struggle with technology is most often and best expressed in the arts. Science fiction provides the best listening post for eavesdropping on humanity's hopes and fears for the role of technology in our future. For instance, in the classic science fantasy *2001*, a monolith sent by beneficent aliens discovers promise in a prehistoric humanity. The device instructs Moonwatcher, an ape-like human, in the uses of violence. The story flashes forward to the modern day, when humans have subdued nature and built powerful technologies. Because of the flammable mix of aggression and technology, the world is on the verge of nuclear annihilation. At this point, human evolution requires mastery of the machine and natural aggression. The alien device reappears, the deus ex machina, and lures humanity into space in hot pursuit. During the journey, a confrontation develops between the human protagonist, Dave, and the supercomputer, Hal. Dave pulls the plug on Hal, narrowly winning the right to lead the evolution of earthly intelligence into space. With the assistance of the extraterrestrials who sent the monolith, Dave is reborn and returns to earth, destroying nuclear satellites along the way, on a mission to end human aggression.

The Happy Dialectic

A second perspective, common among historians and political theorists, is equally fatalistic but more analytic and optimistic. This perspective ascribes social and economic change to a combination of technical, social, and economic factors. In highbrow versions of this view, the interaction of these complex forces in a "dialectic" guarantees "progress" and a happy ending.

According to this view, the interaction of technology, culture, economy, and polity ultimately forces a convergence of cultures, political systems, and economies around the utilization of higher human capacities (Kerr, 1983). Economics is the engine of cultural and political change, and technology is the fuel. The sometimes nasty side effects of technical and economic development are to be tolerated as the price of progress. In the usual scenario, technology pushes productive capacity and creates wealth; rising wealth and expanding markets in turn push technology forward. The march of technical invention automates repetitive tasks, ultimately leveraging the importance of human knowledge at work while eliminating some jobs and deskilling others along the way (Bell, 1983).

For proponents of this second view, the industrial economy is a way station along the route to something better. The version of the future most widely accepted in the United States is the notion of a coming postindustrial era, a vaguely perceived economy in which human intellectual and social skills will dominate technical capability. Economic possibilities will be constrained only by human ingenuity, not by the limits of materials, muscular power, dexterity, or memory (U.S. Congress, 1988, p. 3). In the postindustrial era, information-based technologies and other flexible machinery will supplant rigid mass production technology. The relationship between people and technology will have come full circle from human control to technical domination and back to human control again. Like the artisan's tools, the new flexible technologies will conform to the user, extending his or her productive capacity and reasserting human control over technology (Piore and Sabel, 1984, p. 261). The technical aspects of making things and performing services will be minor parlor tricks. Machines will take on the more rigorous and mechanical aspects of skill, leaving personnel with more human labors. For most jobs, the primary task will be interacting with colleagues and customers, and the required skills will be those needed to imagine designs; tailor products and services to consumers' diverse tastes and needs; and teach, learn from, nurture (physically and psychologically), amuse, and persuade other people.

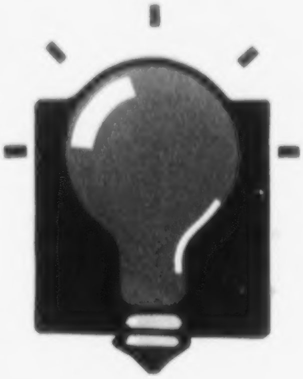
Submissive Technology

A third view assigns technology a more passive role, and tends to view technical change as the consequence, not the cause, of social, political, and economic circumstances. Technology is neutral and malleable, taking on shapes that mirror the culture and polity in which it is embedded, and thereby extends the reach of broad cultural and political forces into the workplace and into our private lives. Proponents of this view put people in the driver's seat. The issue, as they see it, is not the car, but who gets to be the driver.

The notion of a submissive technology has found its greatest currency among the various sects of leftist politics and economics and among some sociological and anthropological schools of thought that regard reality itself as a social construct (Berger and Luckmann, 1966). The view from the left is that the shape of technology conforms to the inherent conflicts between classes. Principal among these class struggles is the conflict between managers and workers over control of the means of production. According to the Marxist interpretation of history, managers and technical elites installed at the pinnacle of organizational hierarchies assert their control by designing jobs and technologies that minimize dependency on workers' skills (Braverman, 1974). Workers resist the employers' attempts to degrade labor into a homogeneous class of low-skilled machine tenders. This conflict results in a complex bargaining process, which in turn produces a hierarchy of jobs in which technical control and rewards at work are disproportionately distributed to white-collar and technical elites, while the mass of workers are relegated to the blue- and pink-collar proletariat. Moreover, according to the leftist critique, this distinction between people who use technology and those who are abused by it reinforces the racial, gender, and other prejudices characteristic of the larger society.

The Dynamic of Technical Change

The origins of economic and technical change are shrouded in myth. Once expelled from the Garden, humanity was forced to use technology to tame nature in order to survive. Myth tells us that Prometheus stole the makings for fire from the gods. The ability to make fire may have been the first major technical breakthrough. The subsequent development of farming and husbandry eliminated the nomadic lifestyle for the majority of humans, but we still had no notion of economic or technical progress. The animistic religions prevalent prior to Christianity made no distinction between the natural and supernatural worlds. In a world where all things were gods' handiwork, the impetus for developing human tools was frustrated. In the Western world, Christianity broke through this impasse by separating this world from the next and encouraging humanity to do work on the world as a form of worship and proof of worthiness. The seventeenth century "enlightenment" separated science from religion as an end in itself. Subsequent improvements in the productivity of farming and population growth created surplus labor, craft production, and the growth of towns necessary to fuel the industrial revolution, which intensified and accelerated.



TECHNOLOGICAL REVOLUTIONS

Where do revolutionary changes in technology come from? Since the beginning of human history, curiosity has been a sufficient reason to tinker aimlessly with technology. How else can we explain Galileo's fascination with helicopters; the early interest in subatomic physics; and nineteenth-century experimentation with waterpower, steam, internal combustion, and electricity? In retrospect, a fair share of our experimental fantasies seem silly—the search for the "philosopher's stone" that would turn all base metals into gold, elixirs that promised eternal life, and "phlogiston," the essence of fire. Occasionally, however, aimless tinkering makes an abrupt entrance into human history in the form of startling inventions that almost always inspire horror in some people and rejoicing in others. Technological change sometimes arrives like a bolt out of the blue, accompanied by "gales of creative destruction" that uproot the current technology and clear the way for some new technical marvel (Schumpeter, 1989).

Cold and hot wars have been the context for unveiling some of our nastiest technical surprises. For example, the metal stirrup gave increased support when fighting from horseback and provided the edge that allowed the Mongol hordes to sweep across Europe and Asia, only to be defeated by a hurricane—a "kamikaze" or "divine wind"—that sank their invading flotilla off the coast of a defenseless Japan (Fairbank, Reischauer, and Craig, 1978). Dr. Gatling's machine gun and the atomic bomb are more modern examples of technical surprises used on unsuspecting enemies in warfare.

Sudden availability of a developed technology where it was previously unknown or resisted can create major discontinuities in social or economic arrangements. Francis Lowell provided the engine of American industrialism when he pirated the secret design for the Awkright power loom, smuggled it into the United States, and set up the earliest American textile factories in

Lowell, Massachussetts, and Saco, Maine (Gibbs, 1950). In New England, the subsequent shift from trapping, logging, and cottage industries to factory work was a wrenching change that brought the social context of work from the outdoors and the family hearth to the artificial environs of town and factory. The Japanese economy and culture made a sharp turn to the West when Admiral Perry, President Fillmore's emissary, arrived on a modern warship bristling with cannon and carrying gifts of modern revolvers and a small working locomotive (Fairbank, Reischauer, and Craig, 1978).

TECHNICAL EVOLUTION

Most technical change comes in relatively small bites in the process of applying technical breakthroughs. Using and commercializing new technologies trigger a series of evolutionary changes and new applications that represent the lion's share of technical progress. Indeed, major breakthroughs in technical knowledge usually result from the accumulation of incremental innovations in the real world. Science may owe more to the steam engine than the steam engine owes to science.

People who tend to view technology as a revolutionary force don't ascribe much economic importance to incremental technical change. They are less interested in the process of building a better buggy whip than in the development of the automobile, which made the buggy whip a museum piece. Yet technical shocks are rare. Most technical change originates in gradual intellectual, social, and economic processes, not revolutionary flashes of genius. A close look almost always reveals that the achievements of geniuses like Darwin, Freud, and Einstein are more synthesis combined with timely and convincing presentation than unprecedented thinking (Stromberg, 1975). What appears to be a fresh assault on the established order is often, in fact, an internal collapse of an intellectual house of cards under the weight of real-world contradictions that have accumulated over long periods of time and can be denied no longer. Even at the installation of the new order, anomalies begin to accumulate as the new axioms are applied outside the ivory bastions of pure thought, and the siege begins anew (Kuhor, 1970).

TECHNICAL PUSH AND SOCIAL PULL

Ultimately, technology is one factor among many in the complex evolutionary process of economic and social change. Technology is sometimes the catalytic agent that transforms elements in the social and economic system and sometimes a by-product of change that begins elsewhere. For instance, the dramatic growth in agricultural invention resulted both from technical changes and the complementary growth of urban populations who needed to be fed. The nomadic hunters and gatherers were pushed off the trail by new agricultural techniques that allowed people to settle down close to crops and livestock. Tools, new methods, and machine technology improved agricultural yields and pushed surplus labor into cities, creating an industrial labor pool. At the same time, new agricultural techniques were pulled along by the creation of urban populations that depended on and could purchase farm output.

Some social and economic systems pull technical changes along faster than others. Culture and religion in the eastern and southern hemispheres have favored rigid social structures and the preservation of natural balances. The result, until recently, has been a general technical passivity and even resistance to change in general and technical change in particular. By way of contrast, Western cultures have exhibited biases in favor of change and progress. These biases, in combination with capitalist economic systems that provide enormous rewards for technical successes and substantial penalties for falling behind, have been powerful engines for technical progress in the Western world (Rosenberg and Birdsell, 1986).

The intricate connection between societies and technology is evident in the story of the wheel. The wheel appears to have been invented anonymously in Sumeria in the Middle East. The Sumerians didn't invent the wheel overnight. They began in 1500 B.C. by using draft animals to haul sledges on runners. The runners eventually became rollers in the shape of solid tubes, then rollers with the ends thickened to roll straighter, and finally wheels attached to axles. Other civilizations in Europe and Asia did not reinvent the wheel, but borrowed the idea from one another, finding the wheel useful to make money and war. With the help of merchants and conquerors, the wheel arrived in what is now Great Britain in about 500 B.C. In contrast, the Incas invented the wheel independently but used it only to make toys and cult objects. Apparently the long developmental process that begins with animals hauling sledges never occurred in the Americas. The Incas used people for hauling. Indeed, almost 3,000 people died hauling one particular stone, according to available chronicles (Adams, 1984, pp. 250-253).

The evolution of the typewriter keyboard presents another interesting case for studying the interaction of culture and technology. In the early development of the keyboard, technical push dominated social pull, but lately, social conventions have proven more important than new technical developments. The original typewriter arranged keys in alphabetical order, but the metal type pieces arranged in a circular basket under the carriage were prone to jamming at high typing speeds. Sholes solved the problem by moving the typing keys that were most frequently used the furthest apart from one another on the keyboard and in the basket of type pieces. The result was the "qwerty" keyboard, named after the top row of letters on the left-hand side of the keyboard. Sholes sold his typewriter to the Remington gun company and the rest is history. The qwerty keyboard still survives despite the fact that subsequent improvements in word processing technology make it unnecessary. The state-of-the-art keyboard is the Dvorak keyboard, developed by August Dvorak at the University of Washington and patented in 1932. This keyboard is designed to provide easiest access to the most used keys. All vowels are in the home row of keys, and the location of keys favors the right hand slightly. Numerous studies demonstrate this keyboard's superiority, but the dead weight of convention and sunk intellectual and financial costs in the qwerty keyboard impede acceptance.

In Asia, culture puts even greater demands on word processing technology. The Chinese language includes thousands of characters. As a result, the typical Hoang keyboard packs a mind-boggling 5,850 characters on a frame that is two feet by seventeen inches. The better Chinese typists can handle eleven words a minute. The Chinese anxiously await voice-activated word processing.

JUNCTURES OF CHOICE

Viewed retrospectively, the process of economic change and the role of technology in that change always seem obvious. Social scientists armed with historical evidence project past events into the present, and tend to encourage the view that past and future are joined along an inevitable trajectory. In reality, however, although there is an element of inevitability in economic and technical change, there is also an element of choice—and sometimes there is more choice than at other times. Periodically, new possibilities or an impasse will create a juncture of choice, which becomes the focus of tremendous social and technical energy. Uncertainty arises and increases risk and potential rewards for risk takers; new trails are blazed. Eventually, one pathway becomes the beaten track while others become overgrown or less traveled. Thereafter, the track narrows as the chosen course is reconciled with other aspects of the social and economic landscape.

Currently, we are at a wide place in the path of technical progress, awaiting choices that will narrow the track of economic and social change. During periods like this one, real and imagined changes can be disruptive and painful. If history is any guide, however, we are unlikely to experience any more disruption than we can handle. There appears to be a variety of forces that counterbalance the possibilities for runaway technical change.

IMPEDIMENTS TO TECHNICAL PROGRESS

Theory into Practice. The interplay between theory and practice is one factor that sets a deliberate pace for technical change. The state of the technical art is almost always ahead of the technical practice because there is an inevitable hiatus between the acceptance of new ideas and their embodiment in new technology. In addition, there is usually a considerable amount of tinkering before someone is penciled in alongside a working invention by patent office clerks and historians. Our heroic view of history encourages us to forget the tinkering. When a workable invention finally arrives, the bouquets go to the people who happen to be upstage for the curtain calls. Their names become part of the cultural lore to be forever chanted like mantras by American school children. The Wright brothers are "first in flight" everywhere but in Connecticut, where the legislature has decreed that Gustav Whitehead made the first flight at Bridgeport in 1901, a year before the Wright brothers' flight at Kitty Hawk in North Carolina.

The Dead Weight of History. Once invented, new technologies are not immediately adopted. Fear, superstition, vested interest, and instability give the past and present a powerful hold on the future. There are many examples. At the turn of the twentieth century, more than fifty years after the first automobile was introduced in England, Parliament still required that speeds not exceed two miles per hour in the city and that each car be preceded by a man on foot carrying a red flag. Cast-iron plows were available in 1837 but were not used widely for more than forty years thereafter because farmers believed iron plows would poison the soil. In the early days of the railroad, stage coach companies persuaded local authorities to stop locomotives at the edges of New York, Philadelphia, and Baltimore, so that each railway car could be pulled to its final destination by a team of no less than four horses (Liebergott, 1984, p. 172).

Sunk Costs. Both the economic and the intellectual investment in current technology and its accompanying infrastructure can impede technical change (Hayes and Garvin, 1982). For example, the shift from water to steam energy was accomplished rather easily because changing the source of power had little impact on other production factors. The shift was relatively inexpensive and didn't require major changes in technologies or work processes, jobs, and skills. Water and steam energy depended on the same system of drive shafts and gears to transmit power to the same factory machines and workers.

In contrast, when an electrical energy supply became available in 1860, existing factories were heavily invested in water or steam and their machine and human complements. Electrical energy had great advantages. Electricity was cheaper to use than water or steam and kept getting cheaper; costs per kilowatt-hour declined by 400 percent between 1880 and 1930. The new energy source was portable, allowing employers to locate close to customers, raw materials, or suppliers instead of near the fast-moving water necessary for water or steam power. The new power source also allowed a more efficient factory layout. The layout in water- or steam-powered factories was driven by the mechanical transmission systems and the need to locate machines in a straight line, with those that required the most energy closest to the power source. In factories using electricity, each machine could be powered by its own electric motor or be wired to a central energy source with no loss of operating power regardless of placement or distance from the energy source. And, most important, the new electrical energy greatly increased the speed and power of machinery: The steam and water mechanical transmission systems lost power with distance from the energy source and couldn't approach the peak power levels possible with electrical current. With increased speed and power, machines could take on new tasks and be used more productively.

Despite the fact that electrical power had made water and steam obsolete by 1880, the use of steam did not peak until 1910 (Rosenberg and Birdsell, 1986, p. 214). In 1890, only 4 percent of American employers and 3 percent of American homes used electricity, and in 1910, the corresponding figures were still only 19 percent and 15 percent. By 1920, 50 percent of employers and 35 percent of homes had joined the electrical energy age. But even as late as 1930, only 78 percent of employers and 68 percent of homes were using electricity (Liebergott, 1984, p. 352).

Sound but shortsighted business practices were a stumbling block to the expanded use of electrical energy. Cost accounting told the employers of the last century that the cost of a new power system and its accompanying infrastructure was substantially more than the cost of using the obsolete power source. Standard accounting has changed little since the nineteenth century. The balance sheet rarely reflects the long-term cost of not switching to a new technology, the competitive position of the institution in the distant future should the competition adopt the new technology, or the barely measurable potential benefits that will eventually accrue upstream and downstream from the technical change.

The inability to swallow the sunken cost in a current technology and its accompanying infrastructure is a persistent cause of the competitive edge lost to those who are willing to push technical frontiers in mature industries. Established technology and supporting infrastructure are especially vulnerable to the competitors who are least invested in the status quo. For example, American manufacturing lost its competitive position to foreign companies that moved to leverage small technical niches into major market shares. German companies, invested in a labor force strong in the crafts and mechanical arts, ultimately lost share to others whose workforce was better able to adapt to the shift to flexible computer-based automation, which relied more on the technician than the mechanically skilled craft worker (Ergas, 1987).

Failures of Imagination. Often the inability or unwillingness to discern the potential benefits of a new technology is due more to a failure of imagination and nerve than to an overreliance on the arithmetic of cost accounting. Most new technologies are used initially to substitute for the technologies they displace. Subsequent changes in the immediate family of compatible technologies and the accompanying infrastructure of the workplace occur incrementally, following the path of least resistance. Thus, in many cases, electricity was used to power the old belts, pulleys, and gear transmission systems that connected water and steam to machines and workers. In a more modern case, flexible manufacturing machinery is sold as a substitute for skilled labor and used with its flexible controls "locked" (Adler, 1988). Also, high-powered personal computers (PCs) are used as typewriters in the office and to store grocery lists at home.

The Lack of Complementary Assets. Once the decision to invest in an invention has been made, a compatible family of technologies is usually required to realize the full potential of the invention. The stereo needs compatible speakers. The automated work station requires further automation upstream and downstream in the work flow in order to feed and consume the increased productivity. In most cases, infrastructure even beyond the immediate family of accompanying technologies is required. For instance, before the Model T could be produced successfully for mass consumption, Henry Ford needed a labor force with the skills and organization to produce the car, a pool of consumers with enough money and credit to buy it, and roads for it to ride on.

TECHNICAL CAPABILITY

Choices as to how to combine people and technology at work are limited by the capabilities of available technologies and the energy sources that power them. Ancient kings could have afforded jet planes but couldn't have them. One assumes the preindustrial citizenry would have welcomed high-quality goods at low prices, but mass production was impossible without waterpower, steam, or electricity and certain advances in the mechanical and eventually electromechanical arts. Who wouldn't want products and services that meet the standards of the new economy? But these products and services were not possible until flexible, information-based technologies came along in the latter quarter of the twentieth century.

To some extent, the history of economic systems is the history of technical capability. Each economic era has been limited by the technical state of the art. In the primitive era of hunting and gathering, energy came in the form of raw muscular power. Eventually, levers, wheels, and primitive implements and weapons multiplied muscular power. In the age of agriculture and craft production, animal power as well as wind and water energy were harnessed to drive mechanical technologies in farming. Production and service technologies came in the form of general-purpose tools that augmented and extended human skill. The characteristic technologies of the preindustrial eras were incapable of producing high volumes at low prices. As a result, neither natural resources extracted from the earth nor manufactured goods were generally available, severely limiting the material wealth available to the average person.

In the industrial era, people harnessed wind, water, and then steam and electricity to drive increasingly powerful and fast machinery producing ever higher volumes of extracted resources, manufactured goods, and services at consistently declining prices. When industrial technology is introduced, it tends to spread. Once a work station is mechanized, productivity increases, forcing mechanization upstream and downstream in order to provide a sufficient volume of feedstock and handle output. The mechanization process ebbs, however, when it confronts jobs and responsibilities that are difficult to reduce into elementary repetitive tasks for mechanization. Products and services produced in small quantities and service functions both within and outside manufacturing have stymied mechanization, for example. Also, within manufacturing and extractive industries, relatively unskilled machine tenders have had to be complemented by more highly skilled craft, white-collar, and technical elites who make the machines, manage the production process, and provide specialized staff services like installation and repair.

Both human and machine capital in the mass production system are relatively inflexible and not easily shifted to alternative uses without incurring prohibitive costs for retraining, capital, and reduced productivity due to downtime. This inflexibility eventually became the system's tragic flaw and ultimate technical limitation, when, in the early postwar decades, consumers began to demand quality, variety, customization, convenience, and timeliness at mass production prices. New computer-based technologies are now bringing us into the new economy by increasing flexibility so the standards of the craft economy and of the mass production economy can be met at the same time.

Indeed, the computer is the seminal technology of the new economy because of its intrinsic malleability. Almost every other technology is significant only for doing something better than some previous technology (Blackburn, Coombs, and Green, 1985, pp. 13-21; Piore and Sabel, 1984; U.S. Congress, 1988, pp. 15-18; Bailey and Noyelle, 1988, pp. 1-3). The new communications technology, for instance, substitutes satellites for cable and can transmit information as well as voice. Biotechnology makes what used to be grown. Laser technology cuts finer and faster than previous tools.

The capabilities of the new information technology take us where we have never gone before. Computers extend the penetration of technology into human endeavor, ultimately expanding both the technical and the human domains. In manufacturing, computers give us more control over the transformation and movement of material. Also, they have the potential to break down barriers between technology and service functions. By automating paper shuffling, a major work responsibility for clerical workers and managers, who make up almost a third of the workforce, computers can effect major productivity improvements that until now seemed impervious to technical penetration (U.S. Congress, 1988, p. 16). The new information technology also breaks the iron link between rigidity and efficiency. Mass production technology had to be scrapped or reconfigured to do a new job, but with flexible software, a product or service can be modified quickly at little added cost.

The new information technology also increases the value of its attendant human capital by allowing a fuller utilization of human capacities. Mass production machinery had a rigid structure to which workers had to conform, but user-friendly software adapts to employees' talents and work styles (U.S. Congress, 1988, p. 16; Baily and Noyelle, 1988). Information technology can also improve the contributions of an organization and its work groups by linking individuals and work teams within the organization as well as by linking the organization with external suppliers, customers, and clients. Information links can improve the performance and market sensitivity of entire networks, sometimes with unforeseen consequences, as in the case of the stock market crash of October 1987.

Evidence suggesting the centrality of technical flexibility in our progress toward the new economy is abundant. One important piece of evidence is the rapid penetration of information-based technology: Investments in this technology now absorb more than 40 percent of all investments in new plants and equipment, compared with 20 percent in 1980 and 6 percent in 1950. In 1987, factory shipments were valued at $48 billion for computers, $18 billion for semiconductors, and $6 billion for copiers. In the same year, commercial software on the market was worth $320 billion and software developed by employer institutions for their own use was worth $200 billion (Clausing, 1989).

Two-thirds of the recent investment in information technology has gone to improve service functions, raising capital-to-labor ratios in services to the level of the ratios in manufacturing (U.S. Congress, 1988, pp. 152-153; Vernon, 1987, pp. 123-124). The microcomputer is a principal investment. One study showed that there were about nineteen employees for every computer in the American workplace in 1985 (Hirschhorn, 1988). Another study showed that about 12.5 percent of American workers used computers on the job in 1984 (Goldstein and Fraser, 1985).

The pivotal role of technical flexibility in the emerging economy is also evident in attempts to reconfigure technologies that are not computer based in order to make them more flexible (Bailey, 1988c; Piore and Sabel, 1984, pp. 261-262). Experimentation with technical layout is an example. In the mass production system, technology and people in manufacturing, extractive, and service industries tend to be grouped on the basis of process or function. For example, there are drilling, stamping, and typing pools. Increasingly, however, machines are being grouped in families and used by broadly skilled employee teams capable of turning out final products and services. This new arrangement is intended to provide better service, facilitate customizing production runs, and provide fast turnaround (Blackburn, Coombs, and Green, 1985).

THE NEW ECONOMIC LIFE CYCLE

PART III

Economic structures are constantly evolving, following a path not dissimilar to an organic life cycle. As a result, the way to use people optimally at work depends on the stage in the life cycle of the particular organization, technology, product line, service, or work process. Traditionally, economic life cycles have tended to have five phases: innovation, installation, competition, maturity, and eventual breakthrough to a new life cycle. In the new economy, however, economic life cycles have sped up and lost their neat sequential structure.

The Classic Economic Life Cycle

INNOVATION

In this phase of the economic life cycle, theory takes its initial leap into practice. The process of making new ideas workable is generally fluid, open-ended, and experimental, and applications tend to show considerable variety. At this stage, economic institutions struggle to exploit new ideas in meeting and shaping market demands. Work processes and organizational formats are generally flexible and characterized by trial and error. The scale of operations is generally small. Job assignments are flexible and overlapping, and skill requirements are general. General-purpose technologies are utilized to allow flexibility and experimentation. Competitive advantage resides with organizations that are entrepreneurial, flexible, and creative.

INSTALLATION

In this phase, each institution settles on a version of the innovation suited to the institution's culture and market niche. Consequently, a variety of product or service designs enter the marketplace at varying costs and quality. Machine capital becomes more specialized to fit these particular designs. Job responsibilities, work processes, and organizational formats become more stable, specialized, and standardized. The scale of operations begins to grow as volume increases, price declines, and market demand accelerates. Skill requirements become more specific and technical. Organizations with the capacity to install the innovation quickly and efficiently have the competitive advantage.

COMPETITION

In this phase, the impact of the innovation results in a rippling wave of minor innovations with economic cycles of their own. Individual institutions begin perfecting their market entries, incorporating incremental innovations in cost-effective production, delivery, and quality. In addition, new applications for the basic innovation are discovered and new markets spin off. Work processes, technologies, job design, and skills are perfected, and become more focused and specialized to match refinements in the original innovation. The scale of production or service delivery increases. Competitive advantage lies with organizations that can capture incremental improvements in the original innovation most effectively. The capacity for continuous learning is especially critical down the line where the product is made, the service delivered, and the customer served.

MATURITY

This phase of the economic cycle is characterized by the emergence of a dominant design and use for the original innovation (Utterback, 1987). The product or service begins to take on the characteristics of a basic commodity, and the experimental quality of the earlier phases begins to wane. The dominant design allows increasing scale and lower costs for production and delivery. Lower costs expand markets rapidly. In turn, the emergence of a dominant design and expanding markets substantially reduce the risks of adopting the innovation and accelerate its dissemination. Competition shifts from innovation to price and marginal differences in quality, variety, convenience, and service. Advertising and sales becomes more important than research and development (R&D) or marketing. Job design, skill requirements, work processes, and machine capital become more stable and predictable. Ultimately, the competitive benefits from the innovation are captured. Institutions compete for smaller and smaller increases in demand, and markets stabilize or become saturated.

BREAKTHROUGH

In the mature phase of the life of an organization, the flow of incremental innovations slows to a trickle. The original innovation is generally available and highly refined. Breaking through to a new cycle of improvements is difficult for a variety of reasons: Mature innovations do not improve rapidly. The central ideas that founded them are usually spent. As a result, the economic returns to further innovation along the same intellectual lines decline. Incremental innovations do not promise substantial increases in markets, yet tend to require substantial costs because a change in one part of the production and service delivery system usually requires other changes elsewhere. Consequently, sunk costs tend to make incremental changes more costly than they are worth by themselves in the short haul.

In mature markets, breakthroughs are especially difficult for established institutions because of their sunk costs in the status quo (Lehnerd, 1987). Such organizations can make breakthroughs only if they are willing to—

- risk resources on innovation despite low returns in the short term;
- incur the high costs of replacing expensive human and machine capital; and
- maintain organizational formats, work processes, and workers capable of generating innovations after markets have matured.

In contrast, new institutions do not have to carry sunk costs or the costs of changes to capture incremental innovations and are therefore often the source of breakthroughs.

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Forever Young: The New Economic Life Cycle

The structure of economic life cycles and associated skill requirements are not the same in the new economy as in the past. Life cycles used to be predictable. They followed a consistent sequence of phases from birth to growth, maturity, and eventually stability and decline (Flynn, 1989, pp. 9-23; Guile and Brooks, 1987, pp. 12-14). In addition, the life cycles of technologies, products, work processes, and organizations tended to be simultaneous, interrelated, and roughly consistent. Young organizations, for instance, sold widely varying products and services in markets where relative shares were still unstable. Technologies and work processes were varied and experimental. Mature organization tended to utilize highly evolved and standardized technologies and work processes to produce fairly standardized products and services in stable markets.

The traditional view of the economic cycle is that it is an inexorable ratchet that progressively deskills work, combining ever more specialized human and machine resources with Taylorist work processes and hierarchical organizations to produce cheaper outputs in greater quantity (Braverman, 1974; Flynn, 1989). Economic cycles in the new economy operate differently, however. They are more open-ended, less sequential, and generally less orderly. For example, today's global institutions leapfrog the initial developmental phases of the economic life cycle. They borrow innovations and compete on the basis of the ability to exploit them, focusing efforts on the latter phases of the economic cycle, when most of the money is made (Ergas, 1987). Also, in the mature cycle phases, competitors have been able to challenge established institutions with high sunk investments by entering niche markets and adopting incremental improvements in available technologies. Often, established institutions in mature markets are vulnerable because they have overly rationalized their technologies, workforces, and work processes to the point of losing all flexibility and becoming incapable of recognizing or adopting incremental innovations or making major breakthroughs. It is difficult for these institutions to maintain the flexibility necessary to stay abreast of change (Dertouzos, Lester, and Solow, 1989; Lehnerd, 1987).

In the new economy, the need to make improvements continuously and quickly makes flexibility of workers and organizations essential in all phases of the economic cycle and at all levels of the organization. In the classic economic cycle, there is a tendency to require flexibility only from senior, white-collar, and technical personnel and only in the initial, innovative phase of the economic cycle. In successive stages of the cycle, the ratchet of specialization tightens to reduce costs and increase the scale of identical outputs. In the new economy, however, it is becoming clear that a labor force segmented into broadly skilled elites and narrowly skilled nonsupervisory employees and a top-down organizational hierarchy can result in costly delays in installing innovations, improving them incrementally, developing new applications for original ideas, and capturing and using learning to encourage breakthroughs.

Economic cycles also seem to be speeding up. As mass markets have expanded, competition has become more global and intense. As a result, the cycle times have shortened, and employees at all levels need deep and broad skills and a reserve skill capacity beyond the requirements in their current jobs to handle the new challenges that come with accelerating economic change (Ford, 1989). The lean, narrowly skilled organization is unlikely to have the flexible resources to manage change.

The growing importance of continuous innovation in the new economy is another novel factor that increases skill requirements and demands flatter and more flexible organizations and broadly skilled employees. In the traditional economic cycle, innovation is a heroic process easily tracked by economic statistics and patent applications. Innovations are generated by white-collar and technical elites, who then design and install specialized machinery and narrowly skilled jobs to exploit these innovations. In the intensified competition characteristic of the new economy, however, inventing and installing major innovations is only the tip of the iceberg of change. Incremental improvement, a process of continuous learning invisible to conventional indices of economic change, has assumed a growing competitive importance. Moreover, the process of continuous learning involves the whole organization, not just white-collar and technical elites. In the new economy, learning occurs from the bottom up as well as the top down, often in the process of making the product, delivering the service, or interacting with the customer. The competitive emphasis on incremental innovation has turned on its head the traditional heroic view of innovation in the economic cycle. The later phases of the cycle and innovative contributions down the line in the organizational hierarchy have increased in importance (Ergas, 1987; Gomory and Schmitt, 1988).

The traditional model has been altered further as markets and organizations have become more complex. Thus far, many enterprises have responded to the new complexity by subdividing institutions into a variety of establishments with work processes, workforces, technologies, and products focused at different stages of the product cycle (U.S. Congress, 1988). Ultimately, however, if the intensity of competition continues to grow, the traditional cycle will foreshorten until it telescopes into a single phase. The human, machine, and organizational capacities associated with each stage of the traditional economic cycle will be required simultaneously.

ORGANIZING AND MANAGING THE NEW ECONOMY

PART IV

Two traditional organizational formats have survived to form the context for organizations in the new economy: large, centralized mass production monoliths and small, decentralized structures characteristic of the services, small business, and craft work. The mass production model for organizing work has survived and become dominant because of its superior ability to generate higher levels of productivity. The trades, crafts, professions, and services have been resistant to this model and survive in uneasy coexistence with mass production organizations.

Mass Production Structures

The dynamic of price competition in mass production has a bias toward standardization, bigness, and conflict. As price competition intensifies, profits from individual units of goods or services decline. Lower unit profits encourage higher volumes. In order to get higher volumes at lower prices, the production or service delivery process is further rationalized and standardized.

The organizational structures of mass production are continuously seeking greater scale. Large scale begets larger scale as production or service volumes increase to cover the fixed costs of ever more specialized and inflexible human and machine capital. In addition, the scale of production encourages even higher volumes in each specialized production unit in order to create buffer stocks of product or service components to ensure uninterrupted production or service delivery. Managers have to be sure that the whole enterprise will not be lost for want of a nail. Moreover, mass production organizations are always extending their boundaries in order to squeeze costs and exert more control. When Henry Ford needed power for his factories, he built or bought power plants both to get electricity more cheaply and to ensure that it would be there when he needed it.

Mass production is biased toward control and competition more than flexibility and cooperation. As an organization grows in scale, the ratchet of specialization makes it more fragmented internally and more dependent on the actions of external parties—suppliers, customers, and governments. Inside the organization, the combination of increasing size and growing fragmentation requires more authority and carefully designed work rules in order to integrate and balance the production or service delivery process. In its external relationships, the organization attempts to control customers in order to ensure demand and to control suppliers by establishing legal relationships and encouraging competition. Governments are regarded as potential sources of cost and destabilization through regulation and economic policy, so the organization attempts to blunt governmental influence through political action.

Services, Independent Crafts, and Professions

Mass production techniques do not easily translate to all kinds of work structures. Even within manufacturing, it is impossible to standardize the work of white-collar and technical elites and to rationalize the work of trade and craft workers down the line. Craft work outside manufacturing, especially in the construction trade, has highly fragmented operations. The entrepreneurial small business sector also seems impervious to increasing scale and productivity, and the professions, such as law and medicine, operate as isolated small businesses with minimal attachment to larger organizations.

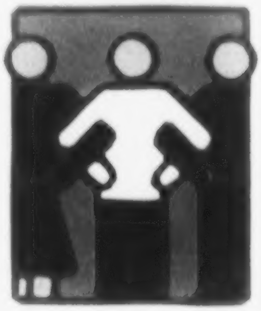
One primary reason for the limited extension of mass production technologies and methods in the crafts and professions is that there is a large element of service in each of these kinds of work. Service work has been resistant to the mass production model because it is difficult to fragment service delivery into standardized components. Almost every crafted product, professional interaction, and service interaction is different.

Generally, work in services, crafts, and professions is less repetitive than work in mass production. Typically, workers are more broadly assigned and skilled. Pay is based more on skill and certification. The work is not standardized, and it is therefore difficult to produce high volumes at low prices using mass production technologies. The advantages of scale are more difficult to attain, so work outside mass production tends to be organized in smaller institutions that produce smaller volumes of goods and services in local, rather than national or international, markets. Moreover, although there have been technical advances in service functions in the form of job aids, service delivery has been resistant to mechanization. The craft worker, professional, or service worker tends to use tools and job aids to deliver a variable good or service; this work is rarely dominated by technology.

Some progress has been made in improving productivity in the crafts, the professions, and service delivery by utilizing mass production organizational formats, careful job designs, and technical job aids. Large-scale organizations, typing pools, typewriters, copiers, and other innovations have allowed the service sector to squeeze some economies of scale.

Organizing the New Economy: The Shift to Networks

Mass production organizations have their virtues: mobilizing capital, conducting research and development, and realizing economies of scale. Even so, these organizations often provide shoddy quality and are too rigid to offer quality, variety, customization, convenience, and timely innovations. The fragmented organization of professional and service work also has its virtues. It focuses on quality, tailoring, and face-to-face customer service. Yet this fragmented structure operates without the benefit of scale; productivity is low, prices are relatively high, capital is unavailable for state-of-the-art improvements, and individual organizations are too isolated to deliver consistent quality.



In the new economy, the top-down industry behemoths and the fragmented service organizations are giving way to new work structures that meld the strengths of prior economic formats and add some new twists. The work structures of the new economy are attempting to meet the standards of both mass production and craft, service, and professional work. Flexibility is becoming the driving force. The volume of products or services may be high or low, and the geographic reach of the organizations in the new economy expands and contracts to serve local, national, and global markets.

As the new economy emerges, work structures are converging on a common institutional format of interdependent networks of people, work teams, and organizations. Mass production institutions are turning to networks to transform their top-down rigidity into more flexible organizational formats; service and craft institutions find themselves using networks to foster greater integration and the benefits of scale.

Network structures grow from within and eventually extend past the boundaries of traditional organizational structures. Inside organizations, individuals become members of work teams. Work teams, the smallest networks, are the basic building blocks of larger networks.

Whole organizations become networks of working teams. In turn, every organization is a member of a network made up of other organizations that are its suppliers, customers, regulators, and financial backers. The rubber, steel, plastics, and electronics industries depend on auto sales. The banker depends on the health of the industries in the bank's portfolio.

The interdependence of economic institutions is not news. The news in the new economy is the growing importance of effective networks. Organizations no longer compete as single institutions but as members of competitive networks. Global competition and the expansion of competitive standards demand stronger organizational linkages, and new communications and information technologies allow organizations to connect with one another and with their customers easily. As a result, organizational relationships in every industry are becoming more interdependent and complex.

The networks that provide final goods and services in the American economy are displayed in Table 6, which shows that most of what we buy requires a mix of natural resources, manufacturing, and services before it becomes a final good or service. Only 15 cents of a dollar spent on food goes to the farmer, but 26 cents goes to manufacturing institutions that prepare and package the food. About 13 cents of a dollar spent on housing goes to the construction sector. Only 30 cents of our transportation dollar stays in the transportation industry. A little more than half of our health care dollar actually buys health care services. More than 25 cents of our education dollar pays for things other than instruction.

There are important differences among economic networks. In general, the more a network produces a pure service, the less complicated the network, whereas the more a network produces a tangible output, the more complex the network. For example, the networks for delivering food, housing, clothing, personal care, and transportation are complex; the networks for health care and recreation are slightly less complex, and the networks for education, personal business and communication services, and government are relatively simple.

The competitive performance of a network depends more on the ability of the partners to work together than on their separate performances. For instance, in the clothing business, the chemical company manufactures and treats the fiber; the textile firm turns it into cloth; the apparel manufacturer turns the cloth into clothing; the wholesaler distributes the clothing to retail outlets; and retailers sell the clothing to final consumers. If the retailers don't sell to the final consumers, all the other companies lose business.

Improving the performance of the clothing network is not simply a matter of improving productivity among its component parts. Imagine you are a trucker who delivers fiber to the textile firm, cloth to the apparel manufacturer, and clothes to the wholesaler and retailer. You will maximize your productivity and be able to charge lower prices if you always arrive with a full truck. Yet if you move smaller batches of materials and final products, you could speed up the network, encourage cost savings from just-in-time performance, reduce "stock outs" at the retail stores, shorten planning horizons, increase the variety of fashion seasons, allow for more tailoring, and generally bring the network closer to customers. At the expense of your own productivity, you could improve the overall performance of the network.

TABLE 6 Economic Networks

Sector	Food	Housing	Transportation	Health	Clothing & Personal Care
Natural Resources	15.0%	9.7%	14.5%	4.3%	4.9%
Construction	3.3	12.9	6.1	3.7	2.4
Low Wage Mfg.	1.5	3.2	2.7	1.5	17.0
Medium Wage Mfg.	16.8	6.8	7.8	6.6	5.2
High Wage Mfg.	8.1	5.7	16.1	5.9	7.6
Transportation, Wholesalers, and Retailers	39.1	12.8	30.1	10.3	39.1
Transactional Activities	12.7	44.7	12.3	15.6	12.8
Personal Services	1.6	2.3	8.0	1.4	10.0
Social Services	1.8	2.0	2.3	50.8	1.1
Total	100.0	100.0	100.0	100.0	100.0
Percentage of Total Nat'l. Output	15.0	23.0	9.0	10.0	6.0

Networks are dynamic, not static. Both the extent of interdependence and the mix of partners change with time. Available evidence suggests that America's economic networks are becoming more interdependent as they respond to more demanding competitive standards and are more easily linked by new information and communications technologies. One way to measure interdependence is by calculating how much of each dollar earned by an organization is paid out to suppliers. A study by the Office of Technology Assessment shows that of each dollar earned by American industries, the average share that went to suppliers increased by 5 percent between 1970 and 1980 (U.S. Congress, 1988, p. 26). Some industry networks are becoming more interdependent than others. High-wage manufacturing, for instance, spent an additional 15 percent of earnings on its suppliers in the latter 1980s than in the early 1970s—a rate of increase three times the national average. A dollar spent on natural resources in 1972 turned over enough times to eventually increase earnings by another $1.30 outside the industry; by the 1980s, a dollar spent on natural resources eventually multiplied into $1.80 in new income outside the industry. Low-wage manufacturing and some service networks became less interdependent during these years, indicating a growing separation between the organizational formats of the old economy and the networks of the new economy (U.S. Congress, 1988, p. 158).

The recipe for producing final goods and services also has changed in virtually every network since the 1970s. Institutions operating in complex and highly integrated networks are involved now in an increasing number of transactions and devoting more resources to transactional activities. These activities—including accounting, legal work, business services, and consulting–have increased by an average of 5 percent in the economy as a whole. The overall increase in spending for wholesale and retail trade, advertising, and communication also reflects the increasing volume of transactions among institutions and the growing complexity of networks in the global economy (U.S. Congress, 1988).

Education	Personal Business and Communication	Recreation & Leisure	Government	Federal Defense	Exports	Total
4.0%	2.6%	6.0%	5.2%	4.4%	16.4%	9.1%
5.2	2.8	3.7	11.0	3.8	3.4	6.2
1.2	1.1	3.5	1.9	1.4	3.8	3.2
4.8	6.7	12.1	6.1	10.9	19.4	9.7
3.3	2.9	7.1	5.0	17.6	19.5	8.7
4.1	6.0	21.7	8.0	8.1	18.8	19.3
7.0	70.9	15.4	12.4	9.0	16.1	23.5
0.6	3.2	14.4	1.4	1.2	1.5	3.7
69.9	3.7	16.2	49.1	43.4	1.1	16.4
100.0	100.0	100.0	100.0	100.0	100.0	100.0
6.0	6.0	7.0	4.0	6.0	8.0	

How to Read This Table: The U.S. economy may be viewed as a series of interconnected networks; the product of one sector works in conjunction with the products of other sectors to satisfy the demand of a consumer for a final good or service. For instance, approximately 15%, or 15 cents, of every dollar spent on food went to the farmer, who works in the natural resource sector of the economy. Almost 40 cents of every dollar spent on food went to pay for transportation and food wholesalers and retailers.

SOURCE: (U.S. Congress, 1988)

In the new economy, each industry network is evolving toward a distinctive organizational mix of large and small institutions. There is no one size that fits all, but some typical patterns of change are discernible:

- ***Oligarchs.*** In some sectors, relatively few firms with tightly controlled subsidiaries dominate. The domination of the American automobile industry by General Motors, Ford, and Chrysler is a case in point. The domestic giants control an extensive network of suppliers. Traditionally, suppliers and dealers were loosely connected to auto producers and forced to compete for business. The new trend, however, is a loosening of top-down control inside organizations, with integration of suppliers and dealers into production networks.
- ***Federations.*** Federations are large enterprises that traditionally do their business through a network of autonomous organizations, branch offices, or franchises. In the interest of capturing economies of scale and developing a greater variety of state-of-the-art products and services, federations in the new economy are using new information and communications technology to provide stronger integration. Banking and franchising are good examples. Central operations provide economies of scale in product development, financial services, purchases of machine capital and other resources from suppliers, training and staff services, and information systems maintenance.
- ***Families.*** Another traditional pattern is a network dominated by a large firm that provides an economic umbrella for a large family of suppliers whose products and services bear the unmistakable stamp of the dominant company. IBM and parts of the Bell system are typical of this particular model. IBM has set de facto standards in software and peripheral hardware for some time. As the new economy emerges, these kinds of networks appear to be becoming more integrated. The relationship between the umbrella organization and suppliers of peripheral products and services is becoming more explicit. The participation of IBM and other high-tech industry leaders in Sematech demonstrates they realize the mutual dependency between small computer chip makers, independent software developers, peripheral manufacturers, and service firms on the one hand and the industry giants on the other.
- ***Loners.*** Some sectors of the American economy have been dominated by highly isolated institutions producing the same or similar products in relatively small-scale organizational settings. In the past, these sectors have operated almost entirely without the benefits of scale or integration. Classroom education, small-scale farming, health care, and home construction are cases in point. As the new economy emerges, the institutions in these sectors are likely to become larger and develop more closely integrated networks. For instance, the market share of builders with volumes greater than 100 houses per year grew from less than 7 percent in 1959 to 67 percent in 1986. And health care agencies facing cost and regulatory pressures are sorting out institutional roles according to cost advantages. Outpatient clinics handle a greater share of noncritical care than hospitals, which are concentrating on critical and intensive care. Nursing homes and hospices are focusing on longer term residential care not requiring critical services.

- ***Entrepreneurs.*** Another typical institutional category includes autonomous, relatively small firms and self-employed entrepreneurs. The high-tech firms of Silicon Valley and Boston's Route 128 are typical of the former; artists, craftsmen, accountants, consultants, lawyers, and doctors are typical of the self-employed. In the new economy, these entrepreneurial institutions are seeking the benefits of integration and scale by forming information networks and trade and professional associations, and by joining larger enterprises through purchase or hire. One result has been a steady decline in self-employment. The self-employed formed almost 20 percent of the workforce in 1950 but only 7 percent in 1986 (U.S. Congress, 1988, p. 184).

Finding a Balance

There is paradox and ambiguity in the operation of the networks of the new economy. These networks simultaneously encourage both integration and autonomy of individuals, work teams, and organizations. Networks are an attempt to have it both ways: They are formed for competitive purposes, but cannot operate effectively without cooperation. By integrating subunits, they enjoy the productivity and resources that come with large-scale delivery. By maintaining autonomy for network members, they allow for the variety, customization, and quality that come with decentralized, more focused production and service delivery. In the final analysis, the success of networks inside and outside organizations depends on the ability to find a balance among competing organizational virtues.

BALANCING ORGANIZATIONAL INTEGRATION AND AUTONOMY

There is a long-standing tension in organizations between the need to integrate and focus employees' efforts on strategic goals and the competing desire to allow employees sufficient autonomy to make their full contributions to the work effort. If the efforts of employees are not focused on strategic goals, organizational efforts will disintegrate into a cacophony of wasted energy. At the same time, employees need discretionary authority to make efficiency and quality improvements and flexibility to provide good customer service.

Mass production hierarchies and the organizations typical in crafts, professions, services, and small businesses face different challenges as they move to balance organizational integration and employee autonomy. The mass production hierarchies, which are already tightly integrated, need to emphasize reforms that promote decentralization and employee discretion down the line. Moreover, as these hierarchies give way to decentralized authority, mass production organizations need to find cohesion through integrative forces other than top-down authority and rigid work rules. In contrast, the decentralized craft, professional, service, and small business work structures, which tend toward autonomy, need to emphasize greater integration in order to improve performance.

In large mass production organizations, the attempt to balance hierarchy and autonomy has led to a common organizational response: a flatter, more decentralized organizational structure that drives autonomy down the line. The relative autonomy of subunits in the organizational network encourages flexibility to help meet competitive standards and exploit new flexible technologies fully. These subunits are integrated by new communications and information technologies, mutually agreed upon values and commitments, new leadership and communications roles for managers, and outcome standards for work.

Managers in large organizations of the new economy relinquish control of work processes to work teams and instead provide organizational integration through leadership and monitoring of outcomes. They also act as listening posts, communicating strategic information down the line and new organizational learning up the line. Managers are responsible for communicating standards and measuring results; when work teams do not meet outcome standards, managers intervene to provide assistance and direction as necessary.

In the networks emerging in professional, service, and craft work, technology is a prime mover in the attempt to achieve greater cohesion. Flexible information-based technologies are capable of automating once impenetrable service and craft functions, and artificial intelligence promises even more possibilities for automation. Performance and pricing standards are emerging in diverse professional and service functions from health care to education.

The isolation of crafts, professions, services, and small businesses is already giving way. Small retail outlets are being integrated into networks by their suppliers. Franchises and chains are substituting for mom-and-pop operations. Physicians work in health maintenance organizations and other forms of organized practice. Architects, engineers, and management consultants work as employees in business service firms. Increasingly, housing is manufactured indoors in modules rather than built entirely outside by construction crews one house at a time.

BALANCING SCALE, SCOPE, AND FOCUS

The organizations of the new economy require the ability to produce large-scale runs of standardized goods and services for national and global markets as well as smaller volumes for local markets. In addition, organizations must be able to focus on individual products or services in order to meet state-of-the-art quality and efficiency standards. Organizations also need to expand the scope of their offerings in order to provide variety and customized products and services to satisfy increasingly diverse demands.

The ability of organizations to balance scale, scope, and focus depends on their flexibility. With flexible technologies, especially information-based technologies, matched to flexible organizations and workers, small volumes of output, variety, and customization add relatively little to price.

One way an organization can achieve scale, scope, and focus simultaneously is to create a network of highly focused subunits. The parent organization can provide capital and infrastructure. Subunits can be dedicated to individual products or services at different stages of the economic cycle, and they can also focus on different competitive virtues. For instance, in a manufacturing setting, one subunit can focus on meeting production standards (productivity, quality, and state-of-the-art product development), while another subunit can focus on customer-sensitive virtues (variety, customization, and convenience). Unlike a traditionally integrated structure, a network can support both sets of organizational values.

Available evidence tends to indicate there is indeed a trend toward using this strategy. Parent enterprises are making more products and emphasizing scope, while individual subunits are focusing on fewer products and services, and delivering scale and focus. The number of products made by individual manufacturing firms increased by 15 percent between 1963 and 1982. Over the same period, each of the subsidiaries and establishments owned by these same firms decreased the number of products it made by two-thirds (U.S. Congress, 1988, pp. 27-28).

BALANCING COMPETITION AND COOPERATION

Ours is an economy based on competitive relationships. Yet in the networks of the new economy, cooperation is at a premium. Individuals, work teams, and organizational partners in networks are relatively autonomous. Each has access to the same information base and flexible technologies. Each is in control of work effort and quality of output. Moreover, in the networks of the new economy, the focus of control over work is constantly shifting. In the product design phase in manufacturing, for instance, authority is shared by design engineers, manufacturing personnel, and sales and marketing professionals; the focus of leadership shifts with the aspect of the product up for consideration. Similarly, in a production work team, authority shifts as the primary expertise required shifts during the work process. In such an environment, fixed authority systems discourage the necessary flexibility. Moreover, the relative autonomy of network partners makes authority a poor lever for improving performance. As a result, structures and processes for cooperation are emerging within and among organizations. The growth of cooperation within firms is signaled by increasing team-oriented work processes and new labor-management efforts that emphasize joint agreements in response to strategic change. Partnering among organizations, the integration of suppliers, and the search for cooperative linkages between public and private institutions are examples of increased cooperation among institutions.

The need for balancing conflict with cooperation extends beyond the immediate partners in a network to more external partners, including customers, suppliers, financial backers, the local and national communities, and governments. Cooperative relations with customers focus the network on their preferences and needs. Cooperative relations with suppliers assure a flow of timely and high-quality inputs in the product or service delivery process. A more hands-on relationship between institutions and their financial backers can encourage more sustained and informed capital commitments. Involvement with the community can foster understanding and support. Community and political institutions that understand a network's strategic agenda can provide useful information and sensible regulatory procedures. Most important, the community and its political representatives can supply complementary assets to assist the network in realizing its developmental goals. Public infrastructure—from roads and bridges to energy, R&D, and a ready workforce—is critical to economic networks.

Institutional Learning

The importance of organizational learning is not news. Since 1929, when national productivity data were first available, the ability of organizational structures to learn to make better use of the available human and machine capital has accounted for more than half of productivity improvements (Denison, 1974). These so-called "process improvements" in productivity are what enable organizations to move up the learning curve—to make more with the same or fewer human and machine resources.

Learning has always been important, but it is even more important in the new economy. It is the common currency of growth and decline in economic institutions. The ability of organizational structures to capture and apply knowledge has become a decisive factor in meeting the expanded set of competitive standards and the key that unlocks the flexible potential of new technologies and organizational networks.

The new standards for competition increase the importance of learning. The constantly changing variety of products and services and the need to customize them accelerate the pace of change, organizations need to learn in order to adapt. The race to market innovations requires organizations to learn even faster. The subsequent race to make incremental productivity and quality improvements and to develop new applications after major breakthroughs also increases the value of an organization's ability to learn while making the product, delivering the service, and interacting with the customer. New information and communications technologies accelerate the pace of change and add to learning requirements by increasing the volume and flow of information.

There are important differences between the old and new economies in the way organizations accumulate and use knowledge. In the old organizations, the emphasis was on learning from the outside in. Major research breakthroughs in theoretical knowledge came from universities and government think tanks. Economic organizations focused on developing basic research into products and services. In the new economy, there is a greater emphasis on learning from the inside out. External research is balanced with more internal development.

In the old economy, organizations focused on exploiting major breakthroughs. Today's organizations must rely more on incremental learning processes. Our competitors have demonstrated all too well that although prize-winning discoveries are proud achievements, it is continuous incremental learning that results in the workaday improvements that are responsible for the lion's share of commercial success.

In the old economy, learning cascaded from the top down; major innovations were developed from outside the organization and rationalized into rigid production or service delivery processes by white-collar and technical elites. There were few systematic attempts to organize in ways that would encourage or capture new learning at the bottom of the organizational hierarchy or at the interface with the customer. In the new economy, learning is pervasive in the organizational structure. Institutions balance learning from the top down with learning from the bottom up. The responsibility for innovations extends beyond the ivory tower to the workaday world, and beyond white-collar and technical elites to the whole workforce. Learning occurs continuously in all phases of the economic cycle.

Learning has important implications for the structure of organizations and networks. Top-down mass production organizations, for instance, discourage learning from the bottom up. The isolated work structures characteristic of professions, services, and small businesses also discourage access to knowledge. In contrast, effective internal networks capture new learning and allow it to flow across functional lines to pressure points in the work process. In external networks, suppliers can provide the push and customers can provide the pull necessary to keep learning moving through the chain of institutions. Equipment suppliers have long been a principal source of innovation in manufacturing, for example. Lately, the suppliers of computer-based and communication equipment have begun to play the same role in service industries. Customers also provide new knowledge. For instance, the Massachusetts Institute of Technology's (MIT) Commission on Industrial Productivity reports that 75 percent of advances in scientific instruments come from users, and that computer chip manufacturers account for two-thirds of the advances in the machinery used to make computer chips (Dertouzos, Lester, and Solow, 1989, p. 102).

Organizing America for the New Economy

American organizations are changing in response to the demands of the new economy, but progress is slow because of a variety of institutional barriers. Old habits that were once successful are hardest to break, and American organizations have been the most successful of the modern economic era. American organizations have also found it difficult to trade competition and adversarial relationships for more cooperative habits. Some of the reasons are historical and profound. Our society is founded on individualism and an explicit rejection of feudal traditions. In contrast, the Europeans and Japanese have a stronger attachment to feudal traditions that emphasize clearly delineated social roles and conventions that provide a strong context for cooperation. In addition, cooperation is all the more difficult when the workforce is multicultural and the economy spans great distances.

The long history of labor-management conflict in the United States has also proven difficult to overcome. Nor have relationships between government and industry moved much beyond arguments over the macro-management of the economy and the dead hand of regulation. The Keynesian truce hammered out in the post-Depression era leaves the government with macroeconomic responsibility and private management with total control over microeconomic decisions, including the allocation of human and capital resources at work and the development of organizational structures. The government intervenes from the outside in, but only to encourage capital investments and to promote workers' health and safety and equal protection (Carnevale, 1985).

Internal and external networks in America are in their infancy. The interested observer needn't travel far to find organizations where workers and suppliers are still viewed as costs to be reduced rather than assets to be

FIGURE 1 Characteristics of Typical Production and Service Delivery Structures

Characteristics	Typical Production and Service Delivery Systems				
	Pre-Industrial Crafts	**Mass Production**	**Services**	**Small Business, Craft & Professions**	**The New Economy**
Competitive Standards	Peer standards for state-of-the-art quality	Productivity: the ability to make more with the same or fewer resources in order to sell cheaper	Productivity, convenience, and customization	Peer standards for state-of-the-art quality	Quality, variety, customization, convenience, and timeliness at mass-production productivity and prices
Scale of Output	Similar products made one at a time	Maximum volumes of standardized goods	Volume and scale limited by the inability to standardize services		Flexible volumes of varied outputs at high rates of productivity
Context for Work	Guild, town, family	Large scale organizational hierarchies	Organizational hierarchies of varying size	Fragmented craft and professional communities	Interdependent networks of work teams and organizations
Human/ Technical Combinations	Large scale organizational hierarchies	Narrow purpose machines matched to narrowly skilled workers	Tools and job aids to leverage performance	Tools, machines, and job aids matched to broadly assigned employees	Flexible information-based technologies matched with adaptable work teams
Source of Control and Integration of Work	Recognized expert status	Hierarchical authority, work rules, and careful differentiation of job assignments		Local business standards, licensing requirements, craft standards and professional prerogatives	Consensus on goals and performance standards
Geographic Reach	Local	National	Local/National	Local	Local, National, Global
Driving Forces in the Work Place	Changing craft standards	The rationalization of work and technical change		State-of-the-art changes	Increasing flexibility of organizations, technologies, and employees
Driving Forces in the External Environment	Urbanization, technical knowledge	Urbanization, technical knowledge, energy (water, steam, electricity), infrastructure (roads, communications, skilled workforce), financial capital	Wealth, the commercialization of home and community functions, the growing complexity of economic activity andn community life, technical knowledge		Global wealth, global competition, flexible technologies, the value of time, the diversification of tastes, commercialization of private services.

How to Read This Chart: The scale of output varies greatly in different kinds of economic structures. In the pre-industrial craft economy, products were similar but made one at a time. In mass production systems, products were made in the highest possible volumes of standardized goods in order to realize scale economies. In services, volume and therefore scale economies were limited because service was difficult to standardize. In the independent crafts, workers like electricians and independent professionals such as doctors and lawyers, produced relatively unstandardized work in low volumes. In the new economy, volumes are flexible and products are varied and customized at prices generally associated with high volumes of standardized goods.

developed. Indeed, much of the overall competitive improvement in many American organizations over the past several years has come from the old-time religion—downsizing and dollar devaluation—rather than more profound changes in organizational structures and attitudes. American networks are weakest in using assets outside the private economy to complement the competitive efforts of private networks. The nation's R&D, educational, and governmental infrastructures remain aloof from the competitive fray and are underutilized for private production and service delivery. Further, there is little internal pressure for our educational institutions or governments to change because they are not market driven. Yet there are plentiful examples of homegrown and transplanted foreign institutions that have overcome these barriers. A closer look at how specific industries are coping with new organizational demands reveals at least some of the diversity of response.

THE AUTOMOTIVE INDUSTRY

The American automobile industry is the largest American manufacturing network. The largest car company, General Motors (GM), employs more than a million people. The auto industry is easily twice as large as any other American manufacturing enterprise and accounts for a fifth of U.S. steel consumption, more than 15 percent of the nation's aluminum consumption, and more than half the American market for synthetic rubber (Womack, 1989, p. 1). The American auto industry once dominated world production but has slipped in recent years to third place. The Europeans and the Japanese both build more cars than we do now, and the Europeans also buy more cars than we do (Dertouzos, Lester, and Solow, 1989, p. 18). The last major innovation of American origin was power steering, introduced in the 1940s. Traditionally, the Japanese squeeze us at the low end of the market, while the Europeans squeeze us in the luxury car market. With the Acura, the Japanese have begun their assault on the middle and high-end markets. As we enter the 1990s, an increase in Japanese transplant manufacturing institutions in North America and losses in market share could push one of the "big three" American companies—GM, Ford, or Chrysler—out of business or into foreign hands.

Turnarounds don't come easy in auto. The industry is large, and so is its turning radius. American car companies face enormous historical obstacles to building organizations for the new economy. Mass production matured at Ford and was perfected at GM. The auto and steel industries were the focus of the nation's difficult labor history. These old habits die hard in the auto industry.

Yet the news is not all bad. American cars are of higher quality than European cars and are within reach of Japanese quality. In 1989, J. D. Power, an independent firm that measures consumer opinion, found that since the early 1980s, consumers have preferred American to European cars, although American cars are still regarded as inferior to Japanese cars (The Power Report, 1989). Data on built-in manufacturing quality show a similar pattern. The defect rate per 100 cars is 52 in Japan, 56 in Japanese transplants in the United States, 90 in conventional U.S. plants, and at a high of 173 in some European plants (Dertouzos, Lester, and Solow, 1989, p. 183). American car companies are also faster at assembly than the European companies, and close to the Japanese. To assemble a car, it takes nineteen hours in Japan, twenty hours in a Japanese transplant in the United States, twenty-seven hours at a traditional American assembly plant, and thirty-six hours in a traditional European assembly plant (Dertouzos, Lester, and Solow, 1989, p. 186). In addition, American auto is one of the industries that have led the nation's productivity turnaround since the early 1970s. Productivity improvements in auto have led U.S. manufacturing; they are superior to European and comparable with Japanese productivity improvements—even if much of the American productivity improvement has come from downsizing. In the United States, the auto industry has led the way in team-based production systems, joint labor-management training, and strategic decision making.

The European and Japanese networks in the auto industry are stronger than our own. The European craft tradition unites education, industry, and labor to develop a highly skilled and flexible workforce. The fundamental strength of Japanese auto networks begins with work teams on the factory floor and radiates outward to supplier groups and conglomerate groups of principal partners and financial backers. Japanese manufacturers have stronger relationships with suppliers than American manufacturers. GM, for instance, makes 70 percent of its car components itself but still uses 6,000 buyers to procure components outside the organization and has 1,500 suppliers per plant. Toyota builds only 20 percent of its own components but has only 177 suppliers per plant.

The importance of functioning networks outside the organization is demonstrated by comparing the experience of Mazda and Chrysler in their separate crises during the 1970s (Womack, 1989). Mazda stumbled when it attempted to sell the gas-guzzling rotary engine. Mazda's conglomerate partners decided the institution was badly led and stepped in with a financial package that mobilized the company and its supplier group in the development of a new line of high-performance engines. In contrast, financial interests and network partners stood by and watched Chrysler go under. After the fall, the affected interests did mobilize, but only to collect from the government a financial package that honored debts and business commitments. Chrysler survived with uncertain prospects and insufficient resources to break through to a new product line that clearly distinguished its niche among the major car companies (Womack, 1989, p. 24).

The American auto industry faces daunting prospects in the 1990s. Product and process improvements, downsizing, and a devalued dollar brought on an auto recovery in the latter half of the 1980s (U.S. Department of Commerce, 1989e, p. 43). After a strong year in 1988, however, markets declined in 1989. The threat of an auto recession looms. More Japanese transplants are arriving as dollar devaluation makes U.S. production more attractive, and world auto production is headed into a glut. As conditions worsen, American companies are going to be tempted to reduce costs and boost productivity. Downsizing, a squeeze on suppliers, and trade barriers offer gains in short-term productivity and are far easier to effect than profound changes that offer long-term benefits, that is, changes in organizational formats or cultures. Quick fixes will buy time, but unless that time is used to work through more profound organizational changes, there will be more trouble ahead for the American auto industry and its vast network of suppliers and financial partners.

THE FOOD INDUSTRY

The network that produces and delivers food to American tables accounts for 15 percent of consumer spending. Food networks promise to become more productive and responsive to demands for quality, variety, customization, and convenience as a result of technical changes on and off the farm. The bar code scanners at checkout counters are the most obvious evidence of the invasion of information technology that will likely integrate food networks from the grocery store all the way back to the farm.

As integration occurs, the scale of organizations in food networks is likely to increase. The number of farms has decreased from a pre-World War II peak of 6.5 million to a little more than 2 million today. Five percent of the nation's farms contribute more than half the nation's farm output (U.S. Congress, 1988, p. 204). By the year 2000, farms with over $250,000 in cash receipts per annum will likely account for as much as 90 percent of production (U.S. Congress, 1988, p. 206). Food manufacturing has become more concentrated, also. The number of food manufacturers has declined at a steady rate of 2.5 percent a year since 1947. Recent growth has been fueled by mergers and acquisitions. In 1985 alone, $14 billion was spent on acquisitions in food manufacturing. R. J. Reynolds bought Nabisco, Phillip Morris bought General Foods, Nestles bought Carnation, and Beatrice bought Esmark.

Retail and wholesale outlets are also likely to continue to grow in scale and in the scope of their offerings. The number of wholesalers decreased by half between 1950 and 1980 (U.S. Congress, 1988, p. 209). The number of small independent specialty stores, such as bakeries, continues to decline, whereas the number of convenience stores that offer a broader array of products with an average sale of $1 to $3 has tripled since the sixties. Supermarkets still account for more than half of sales, but the new "superstores" are challenging supermarkets' dominance. Superstores currently account for only 3 percent of all grocery stores yet garner 28 percent of current grocery sales. Moreover, superstores offer an increasing array of food and nonfood products and services and are likely to capture an even greater share of the market as they continue to expand into computerized shopping and home delivery.

Already, the mechanization of farming and the use of chemical technologies have increased farm productivity to the point where only 15 percent of every dollar spent on food goes to the farmer (U.S. Congress, 1988). As farm productivity increases because of biotechnology, better integration, and increasing scale, a growing share of value added in food networks will go to providing quality, variety, customization, convenience, and timely delivery to the consumer after food leaves the farm. Currently, losses in fruits and vegetables in transit and storage are estimated to run 30 percent, and packaging accounts for at least a third the cost of processed foods, and even exceeds the cost of food products in beer, cereal, soup, baby food, and pet food (U.S. Congress, 1988, p. 207). Therefore, new packaging and preservation technologies promise enormous savings. These technologies also promise improvements in variety and convenience. Foods will be more available long after harvest, over great distances, and in a variety of sizes and stages of preparation.

The availability of new information and packaging technologies will allow small producers a role in the food business if they have the technical capability to access networks. The demand for specialty items from domestic and foreign producers has already expanded substantially, and small producers who can find a specialty niche in a larger network will survive and prosper. At the same time, the advance of packaging, preservation, information, communication, and transport technologies opens markets to more competition at home and abroad. Items such as Israeli fruit, German beer, and Scandinavian chocolate are already traded internationally. As packaging and preservation technologies improve and distribution networks become more sophisticated, we can expect to see more trade in staples.

There is some indication that the quantity and quality of institutional learning in American food processing and manufacturing institutions are not up to the emerging technical and organizational challenges. The middle links in the production chain—those between the farms and the retailers—may be the weakest. Although the learning network that includes the American government, educational system, and farm economy is the envy of the world and is responsible for much of the domestic and worldwide gain in farm productivity, America's food industry, outside of farming, seems to pay less attention to learning than most industries. The Office of Technology Assessment points out that the food manufacturing industry spends only about 0.4 percent of sales on R&D, a rate of expenditure far below the average of about 3 percent for all manufacturing. The large food manufacturers registered only 10 percent of all patents in the industry between 1969 and 1977. The remaining 90 percent of patents were registered to universities, government, and foreigners (U.S. Congress, 1988, p. 208).

THE CHEMICAL AND PHARMACEUTICAL INDUSTRY

The production chain in the chemical and pharmaceutical industry involves the complex process of changing basic elements into economically useful substances. The catalytic agent in the industry has always been learning (Bozdogan, 1989). The modern chemical industry relies on a mix of university-based basic research and large internal programs to develop applications. The industry is very research intensive. Chemical companies spend almost 5 percent of sales on research, and the pharmaceutical firms in the industry spend more than 8 percent of sales on R&D (Dertouzos, Lester, and Solow, 1989, p. 189).

The great chemical and pharmaceutical companies in Europe and the United States were founded on individual laboratory breakthroughs, and the history of the industry and its products is defined by seminal breakthroughs in the lab. In 1857, Perkins developed usable synthetic dyes made from coal tar. Nobel turned unstable nitroglycerine into stable dynamite in 1867. In the twentieth century the industry switched to oil and gas as the basic feedstock for new products with technical improvements in refining. The development of plastics and other substitutes for natural materials launched the chemical boom in the postwar era. Ultimately, the explosion in industrial capacity worldwide resulted in a glut of basic commodities, and the industry began to compete more on price than innovation. The rising cost of oil and gas in the early 1970s reinforced price competition. Product and process innovation fell off as price competition squeezed available resources. In the United States, government licensing, antitrust enforcement, and environmental regulations slowed innovation and reduced R&D still further.

Toward the latter 1970s, the American chemical industry began its successful turnaround by deemphasizing commodity chemicals and diversifying into higher value-added specialty chemicals, biotechnology, and technical instruments. Products are now more varied, customized, and market sensitive. In both the remaining commodity businesses and the more customized markets, the emphasis is on quality more than volume. Moreover, the new specialty product lines are even more driven than before by learning and the timely development of new products. Closer customer linkages are required to develop specialty items; the customer is an active participant in the learning network.

The continuation of this successful transformation will depend on the industry's ability to strengthen its internal organizational structures and external networks. Flexibility is needed to meet the new requirements of specialty markets and to offer competitive quality and convenience to be successful in oversupplied commodities markets. In addition, the industry requires an exponential increase in R&D resources to provide state-of-the-art quality in more diversified and tailored markets. The industry will need to extend its networks further into universities and the government in order to encourage more R&D and participate more effectively in regulatory, antitrust, and licensing procedures.

THE COMMERCIAL AIRCRAFT INDUSTRY

The U.S. commercial aircraft industry continues to thrive, although a glut has developed in small planes and helicopters (U.S. Department of Commerce, 1989c, p. 35-2). The dominance of American producers in this industry resulted from symbiotic relationships between the federal government's military and aerospace infrastructure and the airlines. The demand for military aircraft and aerospace equipment provided revenue, and the military was a principal source of flight and repair personnel. Also, government funding of basic R&D was particularly important because of its enormous cost. It takes $2 to $4 billion to launch a new aircraft, and new engines cost $1 billion to develop. Mistakes are disastrous in the commercial aircraft industry. Boeing, Pratt and Whitney, and Pan American were almost sunk by their investment in the design, development, and production of the 747 until the airplane began to make money. Lockheed's losses on the L-1011 eventually caused the company to drop its production of commercial aircraft. McDonnell

Douglas was almost ruined by the DC-10 and DC-8 (March, 1989, pp. 13-14).

The major threat to American commercial aircraft comes from Airbus, a government-owned aircraft company jointly sponsored by Britain, France, and Germany. As the strength of Airbus grows, the American commercial aircraft network falls into disrepair. Deregulation has shifted the focus of U.S. airlines from technical superiority to price competition. Military and aerospace technologies are no longer transferable in the development of commercial aircraft. Boeing, the major civilian aircraft producer, no longer does any substantial business with the government (Dertouzos, Lester, and Solow, 1989, p. 12). American commercial aircraft companies are now on their own, while their major competitor reaps the advantages of governmental support in technical development and price subsidies.

THE CONSUMER ELECTRONICS INDUSTRY

The United States dominated this industry from 1877, when Edison invented the phonograph, to the early 1960s. During the television boom in the 1950s, the United States had almost total control over domestic and foreign markets in consumer electronics, but less than 20 years later, we were in a complete withdrawal. Virtually all the producers of consumer electronics in the United States are now foreign owned, including RCA, the single largest producer. Zenith, a large producer of television sets, remains the last standing homegrown company in the industry (U.S. Department of Commerce, 1989c).

The collapse of the American consumer electronics industry was caused by its failure to shift from the competitive habits of mass production to the competitive standards and organizational formats of the new economy. American producers sought quick returns from major innovations. As a result, the industry focused on breakthroughs and paid little attention to incremental improvements and new applications. Production systems were driven by cost. Foreign competitors were allowed to capture market niches and to surpass us in production quality, efficiency, and new applications development. As markets matured and price competition squeezed profits from original innovations, American companies got out of the business—first for components, then for individual products, and eventually altogether.

The American abdication of consumer electronics also resulted from failure to develop strong networks for institutional learning. The unwillingness of American companies to invest in continuous improvements after major breakthroughs was paralleled by our universities' and government's general disinterest in consumer applications for electronics. Our Japanese competitors, in contrast, had developed a cadre of technical professionals interested in applications. MITI targeted consumer electronics early in the postwar era. In addition, the Japanese institutions leveraged themselves up the learning curve by extending their networks to include consumers, unlike American companies (Dertouzos, Lester, and Solow, 1989, p. 74).

The VCR provides a case in point. Equipment for commercial video recording was first produced by Ampex, an American firm, in 1956. The machinery was large and clumsy and intended for commercial and professional uses. The market was relatively small, and development costs to build a mass market product were judged to be too high. American companies were not interested. The Japanese learned their way into the business, however, by making components, and eventually video recorders, at relatively low profit margins. The Japanese finally built a cheap and usable VCR, and the market exploded after 1982 (U.S. Department of Commerce, 1989c, pp. 42-45). American firms unable to manufacture a competitive VCR for mass consumption attempted to hijack the new market in the early 1980s with a breakthrough technology—the videodisc and videodisc player. Videodisc equipment was cheaper to manufacture and simpler, but RCA, its principal backer, couldn't get it into the market in time. The Japanese improved the VCR so that by the time the videodisc was ready for market, the VCR was cheaper and superior, especially because the videodisc could not record, but the VCR could (Dertouzos, Lester, and Solow, 1989, p. 74). Since then, the Japanese have moved into the market with a complementary camera, the camcorder, and sales of the two products continue to grow.

As we enter the 1990s, the new battleground in consumer electronics will be high-density television (HDTV). The new HDTV technology promises to revolutionize the industry, spawning a whole new array of products. American companies say they will fight for control over the pivotal technology. The challenge is not only to make the breakthrough and win the technical battles but also to develop the generations of commercial products necessary to win the economic war.

THE CHIP INDUSTRY

Chips no bigger than the tip of your little finger are the basic building blocks of information technology. They store, process, and control information in products ranging from computers to video games. In simple terms, storage devices supply the basic memory capabilities. The memory storage chips are information technology's muscle; processors and controllers are the brain. The circuitry on each chip may include up to 70,000 transistors. As Motorola points out in its ad for one of its chips, in the not too distant past, this much circuitry would have taken up as much space as a large refrigerator and required such a refrigerator's cooling capacity.

The $50 billion American chip industry is an odd mixture of reluctant giants and eager smaller firms. The two largest producers, IBM and AT&T, produce chips only for their own uses. The commercial chip makers include companies like Motorola, Texas Instruments, Intel, Fairchild, AMD/MMI, and a third tier of short-lived companies that tend to arise in order to take commercial advantage of a specific technical change and then disappear when the state of the art moves beyond them. A similar fragmentation is characteristic of the companies that make the equipment that makes and tests chips. A few stalwarts like Teledyne and Perkin-Elmer are in competition with a constantly changing set of quick-start-up companies that tend to come and go with technical and market changes. Moreover, relationships throughout the American network, especially between manufacturers and suppliers, have emphasized cost-based competition over cooperation in network learning.

The U.S. share of world chip production has fallen from a peak of 60 percent to 40 percent at present, compared with a 47 percent market share for the Japanese. The American industry suffers a trade deficit of roughly $1.5 billion. The decline of our position has resulted from an inability to compete in the new economy. Indeed, up until the late 1970s, American productivity was exemplary. The industry managed a 10 percent productivity rate between 1967 and 1979 and more than 4 percent thereafter (Clausing, 1989, pp. 5-6). By 1979, however, American quality was an issue with buyers. American mass production institutions emphasized the commercial exploitation of breakthroughs and paid less attention to incremental improvements derived in the production and utilization of chips.

Moreover, the highly decentralized structure of commercial production in the United States and the relatively small size of commercial producers diminished the benefits of scale and integration, a big disadvantage because in this industry, downturns are frequent and technical changes are rapid and profound. The smaller American producers had less to spend on R&D than their larger competitors overseas and were hit harder during downturns. Companies have not coalesced for development purposes until recently. Also, government R&D focuses on defense and aerospace needs in chip design and manufacture. Although there are important spin-offs from government R&D, civilian needs are quite different. The government seeks peak performance and durability. Volumes are low and cost is no object. Commercial producers need to offer variety, customization, and timely delivery at relatively low prices.

The Japanese chip industry, in contrast, has both the advantages of scale and effectively integrated networks. The Japanese industry developed as a complementary offshoot of firms involved with large computers, consumer electronics, telecommunications, and electronic equipment (e.g., Sony, Hitachi, and NEC). The size of Japanese firms allows greater resources for R&D and sustained development and capital investment, despite the roller coaster of market cycles typical of the fast-paced semiconductor market. The MIT Commission on Industrial Productivity reports that between 1975 and 1982, the American share of patents in the semiconductor industry fell from 43 percent to 27 percent, while the Japanese share rose from 18 percent to 48 percent. By the early 1980s, the Japanese semiconductor industry was spending 28 percent of revenues on capital, compared with 20 percent in the United States. Japanese chip manufacturers spend 12 percent of revenues on R&D, compared with 9 percent for their U.S. counterparts (Clausing, 1989, p. 17).

The Japanese networks are also stronger externally. The large manufacturers own or have substantial financial interest in their principal suppliers (Clausing, 1989, p. 5). MITI, the governmental partner in the network, has played an integral role and focuses its efforts on civilian, not military or aerospace, applications. Japanese financial institutions, now the world's richest, hold substantial equity positions in several of the major semiconductor companies. The strength of the Japanese networks provides staying power over the market cycle, financial strength to drive capital and R&D investments, and a level of interaction that encourages continuous incremental learning, which is critical to meeting the competitive standards of the new economy.

Because of the centrality of information technology, the chip industry is leading the way into the new economy. After two good years, there is likely to be a slowdown in demand in 1990. Although this slowdown will not be as severe as in 1985 and 1986, it will strain available resources for development in anticipation of renewed market expansion in 1991. Thereafter, the demand for chips with memory, processor, and control capabilities tailored to the uses of individual customers will accelerate (U.S. Department of Commerce, 1989c, pp. 30-33; Brandt, 1990, p. 100). The need for stronger customer contact will increase. Product life cycles will shorten. By the mid to late 1990s, superconductivity devices will be important because of increased efficiency in the use of power and higher speeds. As we enter the 1990s, the Japanese seem better positioned to make the technical transition. In 1988, they outspent American chip makers on research by $1.7 billion, and they are likely to expand their research and capital investment margin in this year's slow market. The American hope is that Sematech, an industry consortium focused on military needs, will provide the necessary technical breakthroughs and develop American networks in the industry.

THE COMPUTER INDUSTRY

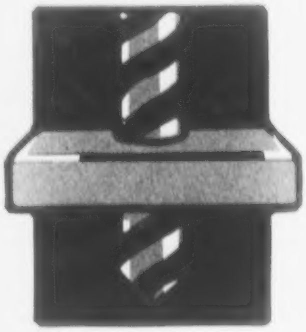
Computers are the pivotal hardware in the new information technology, and America continues to dominate this $160 billion industry. Indeed, this is one of only a few manufacturing industries in which the United States still enjoys strong, although declining, trade surpluses. (Our trade surplus in computers has been more than halved since the early 1980s.) America owes its strong position in computers to an early lead in developing state-of-the-art products. As in the case of commercial aircraft, which also has a significant trade surplus, this lead was due to a strong partnership between industry and government, which was pursuing defense and aerospace objectives. The early American mainframes dominated world markets, and the enormous investment in compatible hardware and software has made consumers reluctant to shift to new computers that would require whole new generations of complementary software, hardware, and human capital. The early success of the industry was also due to its institutional strength. The industry enjoys the combined benefits of scale and strong networks. It is dominated by large, well-financed firms and is organized into networks of suppliers and customers clustered around these firms.

The immediate future of the American industry looks promising, although the pivotal position of computers and other information technologies in the new economy will draw increased competition from abroad. The United States lost some ground in the shift from mainframes to more distributed networks of PCs, yet Apple and IBM have more than held their own in the fast-paced PC market boom of the 1980s. As we enter the 1990s, the market for distributed data processing will grow apace with the development of organizational networks. Demand will increase for expert systems customized for individual networks. Thus, products will become more varied and customized, and sales will shift away from hardware to software and network services (U.S. Department of Commerce, p. 26; Verity, 1990, p. 97). These changes, as well as the need to develop new applications of existing technology, will challenge the industry.

The longer term prospects for the American computer industry are more tenuous. Artificial intelligence and supercomputers more than 100 times as powerful as anything on the market today may be ready for the market by the mid-1990s. If the history of the industry is a guide to the future, then the ability to make, develop, and disseminate breakthroughs first will be critical. The American consortium at Sematech and a similar Japanese consortium are hard at work in the development and design of the new technologies.

THE MACHINE TOOL INDUSTRY

Machine tools are the mechanisms, such as drills, lathes, punching machines, and stamping machines, that cut, shape, and form material to manufacture final products. The makers of machine tools are a small but critical industry. Although there are no more than 500 companies in the business, they are essential in the manufacturing network because they are the principal purveyors of technical change.

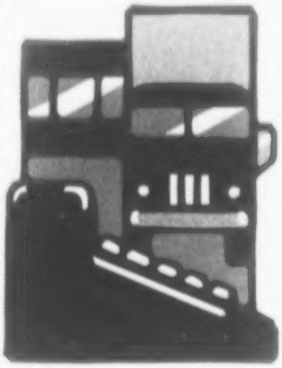


American manufacturers do not make their own machinery; they buy it. And increasingly, they buy it from foreign companies. In the 1960s, the United States was a net exporter of machine tools. By the end of the 1980s, most machine tools were imported from Europe, especially Germany, and Japan. The American industry owes its failure directly to its fragmented structure and the relatively small scale of individual producers. These factors left the industry unprepared to adapt to the demand for flexible information-based machinery. In contrast, MITI was pivotal in building an effective network of relatively small-scale Japanese producers, and strong partnerships between government and industry in combination with a robust tradition in the craft occupations allowed Germany to overtake the American industry (March, 1989; U.S. Department of Commerce, 1989c, p. 20).

After a difficult decade, the American machine tool industry is revitalizing. The growth in the trade deficit has slowed and domestic business has improved as a result of a devalued dollar and industry protections provided by the Reagan Administration in the late 1980s. As in the case of aircraft and computers, the government drives the network toward defense and aerospace applications, so the continued revitalization of the industry will depend on its ability to develop civilian applications.

THE WHOLESALE AND RETAIL INDUSTRY

Wholesale and retail institutions operate at the interface of American economic networks and their customers. There are almost half a million wholesalers in the United States, and they employ more than 6 million workers. The industry reported gross profits of $349.2 billion in 1988. Retailers post annual sales of more than $1 trillion and employ almost 20 million Americans.



Wholesalers and retailers face a challenge in the 1990s: More aggressive integration of networks and a slowdown in consumer buying are likely to result in a shakeout (U.S. Department of Commerce, 1989c, pp. 53-54; Duncan, 1990, p. 85; Weber, 1990, p. 86). Both wholesalers and retailers will compete on the basis of their ability to get closer to their suppliers and their customers. As networks tighten to meet the new standards of quality, variety, customization, convenience, and just-in-time delivery, partners are becoming more dependent on one another. And as dependency increases, each partner has a growing interest in the competitive ability of partners upstream and downstream in the network chain. Wholesalers and retailers become most dependent of all.

Wholesalers are squeezed by falling profit margins and by manufacturing and retail networks that increasingly bypass wholesaling. In response, most wholesalers are using new technology to tighten just-in-time networks and developing new relationships with manufacturers and customers. McKesson Corporation, a large wholesaler of drug and health products, is typical of the wholesale institutions of the new economy. McKesson began losing business to the large drugstore chains and responded by using intensive information technologies to track inventory, packing, and shipping. McKesson then integrated its own information systems with those of the independent druggists. The resultant network has given the independents capabilities they cannot afford individually and a stronger position against the chain druggists. At the same time, the network has preserved McKesson's client base (Johnston and Lawrence, 1988, p. 94).

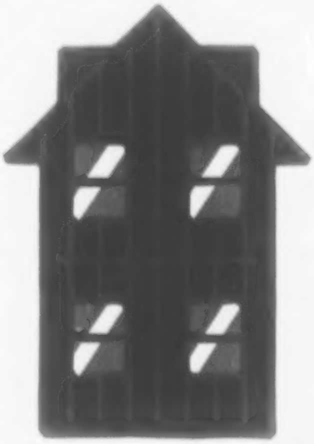
A similar scenario is building in retailing. Specialty stores are successfully taking on large department stores, which are unable to provide comparable quality, variety, customization, and service. The larger stores are responding by strengthening internal departments and building stronger relationships with suppliers and customers. The future of retailing is likely to include a mix of large and small institutions integrated into networks that balance large scale and flexibility. The critical competitive factor in retailing is no longer scale, but the ability to use new technologies and organizational formats to meet new competitive standards.

THE HEALTH CARE INDUSTRY

Health care spending in the United States has increased from less than 5 percent of total spending in the mid-1950s to more than 11 percent in the late 1980s (U.S. Department of Commerce, 1989c). The nation's health bill jumped more than 10 percent in 1989 to a whopping $615 billion. The increase in health care spending is due to a variety of factors, including an expansion in available services and technologies, an expansion of clients as a result of government programs and employer health plans, a greater intensity in the use of the nation's health system, and increasing prices. Health care markets are also expanding, especially in care for the elderly, as previously unpaid care is commercialized.

Despite the remarkable growth of health care as a proportion of the nation's consumer budget, demand is not being satisfied. Moreover, attempts to increase the quantity and quality of service by spending more money on health care result in inflated prices without a corresponding increase in supply or quality. As a result, the increase in demand tends to encourage unacceptable inflation, shortages, and unsatisfying quality of care. The response to the health care problem has been to install cost controls and experiment with health care networks. The future of health care promises increased demand and more aggressive attempts to control costs.

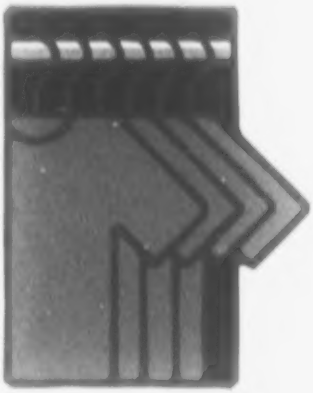
As the health care industry moves ahead, it will be forced to develop more carefully integrated networks. This process of rationalizing is typical of how the service sector is responding to the new economy. New information-based technologies are cutting paperwork costs, integrating service delivery, and allowing more time with patients. More and more professionals are on staff rather than operating as private entrepreneurs. Health care organizations are sorting out their roles in the service network. Hospitals are becoming specialists in critical care, and other services are shifting to ambulatory care facilities, nursing homes, specialized testing and technical facilities, and private homes. Consumer participation in service delivery is increasing, especially in preventive care and use of user-friendly health care gadgets.



THE HOUSING INDUSTRY

Americans consistently spend about 20 percent of their income on housing. As incomes rise, the cost of housing rises, too. New residential construction was valued at almost $200 billion in 1988 (U.S. Department of Commerce, 1989c, pp. 1-4). The demand for high-quality housing in the United States exceeds supply. As a result, as in the case of health care, market expansion efforts are focused on improving efficiency in production. Housing production in the United States is not efficient, and productivity is actually declining. Only mining has a worse productivity record. Although the decline in mining productivity is traceable to improved safety regulation and therefore justifiable, the productivity decline in housing is due to the excessive fragmentation of the housing industry itself. A house has 15,000 parts, the same number of parts as a car, but houses are assembled almost entirely by hand on-site. Because of its excessive fragmentation, the industry has impressive flexibility, but has been unable to mobilize long-term capital or provide the R&D necessary for long-term economies of scale.

Many observers believe that the U.S. industry needs to emulate the housing industries in Sweden and Japan. There, housing construction is integrated in manufacturing institutions that utilize more machine capital than in the United States, and the workforce resembles that of high-tech manufacturing. Advocates for manufactured housing argue that a marriage between manufacturing organizations and new flexible technologies such as computer-based design would result in cheaper, higher quality, and more customized housing. In the future, the American housing industry will likely evolve toward large-scale housing manufacturers that will employ more white-collar and technical professionals, fewer craft workers, and more on-site housing assemblers.



THE APPAREL INDUSTRY

New technology and organizational networks pioneered by the Italians provide stronger linkages between retail outlets and the chain of institutions that produce fiber, cloth, and apparel. Over the past two decades, networks of small firms have replaced all but one of the large Italian apparel companies. The Italian networks are the world-class leaders in the just-in-time production and delivery of high-quality clothing (Johnston and Lawrence, 1988, p. 96).

The clothing industry appears to be evolving toward a structure and technology that will allow converting fiber to finished apparel, tailored to individual tastes and measurements, in a matter of a few weeks. Moreover, the industry analysts argue that this quickly produced tailored clothing will be no more expensive than current mass-produced items. Eventually, customers' measurements will be stored electronically. Customers will select cloth and style alternatives at the retailer, and the clothing will be made and delivered within days. In the space of a few hundred years, clothing markets will have gone from tailoring to mass production and come full circle back to tailoring again, only this time with streamlined efficiency and economy.

THE FINANCIAL SERVICES INDUSTRY

Financial service markets grew from 4 percent of purchases in 1955 to more than 6 percent of purchases in 1985 (U.S. Congress, 1988). The growth in market size resulted from an explosion in the variety of products and services available, the use of information technologies to provide variety and tailored financial packages, and improved quality and convenience. From the post-World War II era to the 1970s, the profits in banking were made by selling checking and charge card accounts to families and businesses through a growing network of branch offices. By the late 1970s, upwards of 80 percent of the estimated checking account market was taken (Noyelle, 1988a). The competitive pressures stemming from the saturation of existing markets in combination with new, flexible information-based technologies resulted in an explosion of new products and services. Market expansion also resulted from the utilization of the new technologies to deliver high-quality customized services conveniently. Electronic transfers, tailored financial packages, and teller machines are some of the more commonplace advances in the industry.

Since the 1970s, growing market potential and deregulation have drawn a motley set of institutions into the competitive fray, accelerating the pace of change and increasing overall volatility. Lately, the industry has been shifting from a highly fragmented structure to a complex one that emphasizes both global and local market development. Small institutions are focused on geographic, industry, or functional niches—but oftentimes under the umbrella of partnerships or parent enterprises.

JOBS AND THE NEW ECONOMY

PART V

The new economy is affecting jobs in three ways. First, it is affecting the overall quantity of jobs created. Second, it is influencing the distribution of jobs among industries, occupations, geographic areas, and organizations of different sizes. Third, it is affecting the quality of jobs, as measured, for example, by wages, job security, and opportunities for career and personal development.

The Quantity of Jobs

The American economy is expected to add 1.5 million new jobs each year between now and the year 2000 (Personick, 1989, p. 25). Whether this expectation is realized will depend on a variety of factors. The overall quantity of jobs is determined by a mix of macro- and microeconomic factors. In the short haul, the macroeconomic factors are dominant. Low levels of consumer demand, tight money, and high interest rates squeeze economic activity, inhibiting human and technical investments and job growth. Why hire more people to make more and better widgets if you already have too many widgets at the warehouse? Restrictive business environments also encourage an exaggerated attention to cost savings. Because personnel costs run as high as half to three-quarters of total costs, attempts to reduce costs will inevitably focus on reduced hiring, especially in full-time positions. In the worst-case scenario, a sustained downturn in the business environment can discourage demand for human development and reduce potential job growth of an economy. Sustained slowdowns in demand will not only inhibit job opportunities in the current economy but reduce them in the new economy as well. In contrast, sustained growth will provide a robust context for job creation.

Demography drives the overall quantity of work, also. More people create more demand for goods and services and more willing hands to make and deliver these products and services. American job growth was 2.3 million jobs per year in the 1970s. It is expected to decline to 1.5 million jobs per year in the last decade of this century principally because of the slowdown in population growth in the wake of the baby boom (Fullerton, 1989). But this reduced growth is not necessarily bad news. Economies with fewer people tend to invest more in the people available and arm them with more capital at work. The result is increased economic potential. In contrast, when there is an ample supply of workers, it is tempting to substitute muscular for mental power, a practice that reduces economic potential as human capital essential for technical and organizational development decays.

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America's present macroeconomic prospects are mixed. Large budget deficits, high interest rates, and the natural ups and downs of the business cycle suggest there will be some retardation of job growth in the near term. The longer term macroeconomic prospects are more favorable. Budget deficits are declining, freeing up private resources for investments in the domestic economy. Worldwide demand should continue to increase as the United States and other nations develop formal mechanisms and informal conventions for mobilizing and responding to global demand.

Our demographics are equally mixed. As the baby boom moves into its high-productivity years, there should be marked improvements in the quality of human capital on the job. There should also be more financial capital available to buy technology as the baby boom moves into its high-savings years and as the demographic demand for housing declines. The combination of a seasoned workforce and more available capital for investments in human resources and machines should ultimately bring more robust growth and create more jobs. The demographic wild card in America's competitive hand is the declining quantity and quality of human capital at entry level. The cohorts that follow the baby boom are much smaller and belong disproportionately to groups in which our developmental investments have been grossly insufficient. In some respects, the declining quantity and quality of entry level employees is a happy problem. The scarcity of entry level workers will guarantee work for those who are prepared, inspiring better preparation among people whose prospects have traditionally been limited, and greater willingness among governments and employers to invest in young students and workers. For the first time in memory, the nation's cultural and political commitment to economic opportunity will coincide with emerging economic necessities.

Good Jobs, Bad Jobs, and No Jobs at All

Although the new economy will likely create jobs in the aggregate, the processes of economic change will inevitably distribute new jobs unevenly. New technologies, the globalization of economic activity, and organizational changes will create good jobs for the majority, result in bad jobs for some, and take away jobs from a few. Moreover, the jobs created by technology, trade, and competitive changes almost never go to the people who have lost their jobs because of these forces. In the 1970s and 1980s, the typical job loser was a midwestern male who was over thirty years old, had a high school diploma, and worked in manufacturing. The typical job gainer was an east- or west-coast female who was in her early twenties, had a two- or four-year post secondary degree, and worked in services.

The unequal distribution of burdens and benefits as we move toward the new economy is being exacerbated by concentrated technical and economic changes in specific occupations, industries, and geographic areas. Computers and modern communications technologies have reduced entry level job opportunities in office settings. Automated manufacturing is rapidly eliminating low-skill entry level jobs in manufacturing as well as jobs for laborers, material handlers, machine operators, and craft workers while creating jobs for technicians, mechanics, and repairers. In the future, manufactured housing may devastate the construction trades while creating new jobs in housing that are akin to the white-collar and technician jobs found in manufacturing.

In addition, as economic activity globalizes and trade advantages shift, recessions are becoming more specific to particular industry networks. Industry recessions begin in organizations that supply final goods, then move through the chain of suppliers. For example, auto recessions that begin at GM, Ford, and Chrysler eventually roll through supplier institutions in the steel, rubber, and electronics industries.

As a community, we are challenged to redress the unequal benefits and burdens characteristic of the new economic environment. Those who benefit from technical change and free trade need to share their good fortune with those who are victims of machines and foreign competition. The employed majority will need to be sensitive to both the poor and the dislocated. A new social compact will be required. The development of such a compact will not be easy in a polity accustomed to responding to majority concerns. In the current political context, the dislocated employees are the forgotten constituency. They are neither an effective political majority nor a truly needy minority.

The first step toward building a new social compact will be for Americans to recognize that ours is a society based on work. A job is the price of admission to this individualistic culture and participatory polity. People unable to find work eventually disappear from the community, drop out of the American political system, and fall into the underground economy. These same destructive processes are at work for both the poor and dislocated workers. There is no fit measure that allows us to choose between the suffering of these two groups. The chronically poor tend to start out and end up at the bottom of the economic heap. Dislocated employees experience an economic loss that rarely results in persistent poverty but probably involves an equal amount of suffering. In the case of dislocated employees, it's not so much where they land that hurts, it's how far they have to fall.

The Distribution of Jobs

Looking beyond the aggregate numbers to the kinds of jobs the new economy is generating reveals a pattern fitted to the emerging demands of the new competitive standards and networks. Indeed, understood in this context, the changes begin to make sense and provide less cause for alarm. The concern over the relative job growth in manufacturing versus services is a case in point. To equate the growth of service jobs with a decline in the quality of jobs available is misguided. The phenomenal growth in service jobs is not a result of competitive failure. Instead, it reflects the growing service content all industries require to meet the new competitive standards and maintain networks. We are not abdicating basic industries. Indeed, manufacturing output continues to grow. The loss of jobs in basic industries can be understood, at least in part, as a result of competitive restructuring of jobs. Production workers are being displaced by a smaller number of technicians, who use more technology to produce vastly greater levels of output per worker. Meanwhile, manufacturing jobs in management and other service-oriented functions are growing. In fact, even though there are fewer manufacturing jobs, they are more important than ever because they are located at the generative core of our most advanced and critical competitive networks.

THE CRITICAL ROLE OF NATURAL RESOURCES, CONSTRUCTION, AND MANUFACTURING

Not all jobs are created equal in the new economy. Economic activity in natural resources, construction, and manufacturing has the generative power to create jobs in other industries. Only a quarter out of a dollar spent on natural resources stays in the industry. The rest goes to other industries: a dime to construction, almost 30 cents to manufacturing, 16 cents to transportation and wholesale and retail trades, 11 cents to transactional activities, and 8 cents to services. Similarly, the construction industry keeps only about 36 cents on the dollar; low-wage manufacturing keeps 48 cents; medium-wage manufacturing keeps 45 cents; and high-wage manufacturing keeps only 43 cents.

Service-oriented industries are more self-contained. They operate at the periphery of networks centered on manufacturing, natural resources, or construction. Money spent directly on services creates fewer jobs elsewhere. Thus, 62 cents of every dollar spent on transportation or wholesale and retail trade stays in the industry, and the transactional services industry retains 57 cents of every dollar. Fifty-five cents of every dollar spent on personal services stays with the provider, and no one industry gets more than a dime's worth of the remaining 45 cents. Social services are the most insulated of all, with 75 cents of every dollar retained (U.S. Congress, 1988, p. 157).

THE SERVICE REVOLUTION

The most noticeable trend in the kinds of jobs typical of the new economy will be a continuation in the shift toward service work. In the last decade of the century, manufacturing employment will decline by an estimated 300,000 jobs, and extractive jobs in agriculture and mining will decline by a similar number. In contrast, service jobs are expected to increase by almost 17 million (Personick, 1989, pp. 25-26).

There are many reasons for the increasing share of service jobs. One reason is that people satisfy their material wants early as they climb the income ladder. A consumer can eat only so much food, drive only one car at a time, and sleep under only one roof. As a result, a declining share of rising incomes goes to material goods, and a rising share goes to services such as education, personal services, health care, recreation, and environmental services (U.S. Congress, 1988, p. 7).

Also, the share of jobs going to services is increasing because more and more extracted and manufactured goods are being made with fewer and fewer workers. Productivity in manufacturing and extractive industries has outstripped productivity in services for hundreds of years and continues to do so. The cost of a television set was equivalent to four days' work in 1950, one day's work in 1972, and only four hours' work in 1986 (U.S. Congress, 1988, p. 64). Between now and the next century, manufacturing output will increase by 2.6 percent per year, while the number of manufacturing jobs will decline by 0.1 percent per annum (Personick, 1989, p. 33). Production workers in manufacturing will be replaced by a smaller number of technicians who will work with more technology. The number of technicians will increase by almost 100,000, but the number of operators and laborers will decline by 700,000 by the year 2000.

The competitive requirements of the new economy are a third reason for the increasing proportion of service jobs. A substantial number of new service employees will be required to design, develop, and market a variety of timely, state-of-the-art products in a complex global environment. In manufacturing, for instance, there will be a loss of production jobs but a gain of almost a million jobs for managers, professionals, and marketing and sales personnel (Personick, 1989, p. 27; Silvestri and Lukasiewicz, 1989, p. 45).

The increasing number of transactions among complex economic networks also encourages demand for service workers ranging from sales and customer service personnel to lawyers and accountants. Compared with 1972, in the mid-1980s, an additional nickel out of every dollar spent in all economic networks went to pay for transactional activities (U.S. Congress, 1988, p. 160). As economic networks become more integrated, individual employers will need more employees in service occupations. Business services such as personnel, computer, research, and consulting services will account for one out of every six new jobs between now and the beginning of the next century. As the number of transactions in networks increases, the number of jobs for people doing the buying and selling will increase as well. Retail trade jobs are the fastest growing category of service jobs, and their number will grow by more than 3 million between now and the next century (Personick, 1989, p. 25).

The number of jobs in information services will increase dramatically to integrate economic networks. The demand for electronics engineers will increase by more than 40 percent, and we will need half again as many computer scientists in the 1990s as in the 1980s. The number of mechanics and installers and repairers of technology will increase by 13 percent overall, with a 60 percent increase in computer equipment repairers (Silvestri and Lukasiewicz, 1989, p. 51). Computer services are the fastest growing of the business service industries. Demand for all computer-related occupations will grow by almost 5 percent a year in the 1990s, compared with an average total job growth in the American economy of 2.3 percent a year in the 1970s and 1980s.

THE GEOGRAPHY OF JOBS

There are contending technical and competitive forces at work in the emerging geographic distribution of jobs. Technical changes are freeing work from its geographic restraints while competitive realities are concentrating jobs in networks of metropolitan areas.

There are a variety of forces encouraging dispersion of jobs. As raw material becomes a less important ingredient in every production recipe, proximity to raw materials becomes less important. In addition, location near major transportation nodes becomes less important as networks are connected more by information and communications technology and less by physical transport. Moreover, advances in air transport reduce the importance of location near natural overland and water transport sites. Finally, the technical ability to reach far-flung domestic and global markets has resulted in a self-propelled extension of competitive networks beyond local markets.

But at the same time, the new competitive requirements tend to concentrate job growth in population centers. The increasing service content of economic competition encourages proximity to allow personal contact both inside and outside the organization. Concentration of partners among and within metropolitan networks is further encouraged by access to rapid transportation and the high concentration of customers in urban areas. Moreover, the centrality of learning in the new economy encourages location in population centers with access to educational and R&D infrastructure. Therefore, most new jobs are being created in the extensive networks of the densely populated metropolitan areas (U.S. Congress, 1988, pp. 190-200). Most jobs are being created on the two coasts, where population density is greatest. In the South and West, most new jobs are in urban areas. The urbanization of job creation does not preclude rural or small-town development. The ability of smaller communities to develop their economies, however, depends more on their ability to find a niche in a broader network and less on their ability to develop independently.

INSTITUTIONS BIG AND SMALL

Are most jobs created by big or small employers? It all depends on what is meant by "big" and "small." Let's look at the numbers. Currently five out of six American employees work in institutions with less than 1,000 employees. This group is divided almost equally among institutions with less than twenty employees, with between twenty and ninety-nine employees, and with 100 to 999 employees. The share of new jobs created by firms with fewer than 100 employees has increased to 40 percent, although these firms' share of economic output has declined (U.S. Department of Commerce, 1989c; U.S. Congress, 1988, pp. 27, 183). The fastest growth in jobs is occurring in establishments owned by larger enterprises—a fact that is not surprising in an era when organizations are trying to balance scale, scope, and focus by utilizing organizational networks (U.S. Congress, 1988, p. 27).

In the final analysis, the debate over job creation in big versus small institutions misses the mark because it ignores the central organizational reality of the new economy. That reality is the growth in networks that integrate large and small institutions in order to capture and balance the benefits of large scale and the flexibility and focus of smaller organizations.

The Quality of Jobs

Measuring the quality of jobs is complex because they provide a variety of benefits. Work provides wages and independence in a culture that values both, and in a society based on work, job security is critical to family life. For most of us, work is also the crucible for our individual and career development. The pages that follow assess the jobs of the new economy on the basis of their ability to provide good wages and job security, as well as career development.

Wages: The Importance of Learning

Wage growth in the United States has been flat since the early 1970s (Bound and Johnson, 1989). Principal among the reasons for this stagnation is our poor productivity performance, but there are other reasons as well. Labor productivity has outpaced wage increases, in part because an increasing share of the productivity dividend has gone to pay for the capital requirements of the new economy (U.S. Congress, 1988, p. 373). Another portion of the productivity dividend has come out of wages to pay for the increased cost of benefits, especially health care benefits. Yet another share of the meager productivity dividend has gone to retirees. In addition, the pressure of international wage competition, especially for well-paid manufacturing jobs, has held wages down (Murphy and Welch, 1989). Moreover, as female participation in the workforce rose from 39 percent in 1973 to 45 percent in 1988, overall wages declined because the average wage level for women is only 64 percent of the average wage level for men (Kosters, 1989, p. 7).

Despite flat overall wage growth, there have been dramatic shifts in earnings among different groups of Americans. Wage increases in the new economy are rationed with an increasingly uneven hand, resulting in a growing maldistribution of income in the United States. More now than ever, learning is the rationing hand that distributes earnings in the American economy. People with the most education and access to learning on the job are doing best; those with the least education and least access to learning on the job are doing worst.

TABLE 7

Earnings Advantage of College Versus High School Graduates After Ten Years at Work (By Percentage)

Year	Males	Females
1973	49	49
1978	36	38
1980	31	37
1983	45	46
1988	86	60

How to Read This Table: In 1973, men and women with college degrees and ten years of work experience earned 49 percent more than men and women with high school degrees. This advantage fell in 1978 and 1980 but began to rise in 1983. By 1988, male college graduates enjoyed an 86 percent advantage and female graduates a 60 percent advantage over high school graduates. *SOURCE: (Adapted from Kosters, 1989).*

Formal education, especially college education, boosts earnings greatly in the new economy. People with good educations have always had an advantage, but they are doing better now than ever before. For instance, Table 7 shows that the returns to education declined between 1973 and 1980 but made a phenomenal comeback in the 1980s (Kosters, 1989, p. 24). In 1973, a college graduate with ten years' work experience earned 49 percent more than a high school graduate with ten years' work experience. By 1978, the college graduate's advantage had declined to 36 percent for males and 38 percent for females. After 1980, the advantage of college graduation over high school graduation began to rise again, reaching 86 percent for males and 60 percent for females by 1988. In a telling analysis of available data, Levy has demonstrated that postsecondary graduates will ultimately exceed their parents' earnings but high school graduates will not (Levy, 1987, pp. 141-142).

The returns to postsecondary education for both two-year and four-year schools are substantial in every occupational category. In 1987, managers with high school diplomas earned $23,306 on the average, but managers with college degrees earned an average of $37,252. Technicians with high school diplomas earned $21,358, compared with $23,830 for technicians with some postsecondary education and $28,004 for those with four years of college. In service occupations, workers with high school diplomas, one to three years of postsecondary schooling, and four-year college degrees earned $13,093, $16,937 and $21,381, respectively (Silvestri and Lukasiewicz, 1989, p. 63).

The returns to postsecondary schooling are reinforced by the synergy between schooling and learning on the job. People with the most schooling have access to the jobs with the most formal and informal training. College-educated managers and technical professionals get substantial formal and informal training on the job. Non-college-educated employees who have high school diplomas plus some formal postsecondary training (e.g., supervisors; technicians; technologists; and craft, skill, data processing, and sales employees) also get substantial formal and informal training on the job. In general, workers who get formal training have a 30 percent earnings advantage over those who don't (Carnevale and Gainer, 1989).

These data understate the demand for learning in the new economy. What is most remarkable is that the returns to education and learning on the job have remained high and grown even while the supply of educated workers has been constantly on the rise. It is surprising that the dip in the 1970s was not deeper. Since the turnaround, the supply of high school and postsecondary graduates has continued to increase. The proportion of college graduates among males in the workforce has gone from 20 percent to 24 percent since 1980. The proportion for females has increased from 16 percent to 21 percent.

Why are the returns to postsecondary schooling increasing so rapidly? The principal reason is that the competitive demands of the new economy require more learning both in preparation for work and on the job. As a result, employers are using a higher educational standard to sort among job seekers at entry level, and the fastest growing job categories require postsecondary schooling (Silvestri and Lukasiewicz, 1989, pp. 44, 47). At present, the distribution of American jobs can be divided roughly into thirds: One-third require elementary schooling; one-third require high school education plus two years of postsecondary schooling; and one-third require college education. Since the early 1970s, the proportion of jobs requiring grade school only has declined while the proportion of jobs requiring postsecondary schooling has increased steadily. Other reasons for the growing returns to postsecondary schooling are a shift by students toward technical and business subjects and a general tightening of college entry standards in the latter 1970s (Bishop, 1989).

RACE, SEX, AND ETHNICITY

Job opportunity in the new economy has not been neutral with respect to race, sex, and ethnicity. The new configuration of occupations and earnings tends to favor progress in women's wages. The shift away from natural resources and the factory floor to service functions in all competitive networks reduces the proportion of male-dominated occupations in the workforce. Also, women have been more aggressive than men in pursuing schooling and in utilizing learning to leverage career development. In 1963, 34 percent of 18- to 19-year-old men and 23 percent of 18- to 19-year-old women were enrolled in college. By 1975, the figure for both sexes was 34 percent, and in 1988, 48 percent of 18- to 19-year-old women and 37 percent of 18- to 19-year-old men were enrolled in college. Although women have lower status than men in most organizations, women participate in formal training programs at work in rough proportion to their participation in the workforce (Carnevale and Gainer, 1989). These factors, among others, account for an increase in women's average earnings from 59 percent to 64 percent of men's average earnings during the 1980s (Bound and Johnson, 1989, p. 3).

The new economy has not been nearly so kind to minorities. For instance, in 1963, the average black male earned 63 percent as much as the average white male, and by the early 1970s, the percentage was up to 75. These earnings gains then stalled, however, and in the 1980s, the earnings differential between black and white men widened. By the late 1980s, the average black man was earning less than 70 percent as much as the average white man. The earnings differential between Hispanic and white males has widened also—from 73 percent in 1979 to 65 percent at the end of the 1980s. Moreover, if benefits and earnings other than wages are included, the differential between white males and their black and Hispanic counterparts is even greater. A similar pattern is evident in the economic progress of other minorities.

A principal cause of the stalled progress of minorities has been the increasing value of education in providing access to good jobs and learning on the job (Juhn, Murphy, and Pierce, 1989, p. 38). Minority educational attainment has not kept pace with the increase in years of schooling among the majority population, nor have minorities had access to jobs with formal or informal training.

Minorities are concentrated in jobs that pay the least, provide the least formal and informal learning, and show the least improvement in wages. For instance, in 1988, blacks made up 10 percent of the workforce (Fullerton, 1989, p. 8) yet had only 6 percent of the managerial jobs and 7 percent of the professional jobs. Blacks are disproportionately represented in dead-end clerical jobs. About 22 percent of mail clerks and messengers are black. Blacks are overly represented among low-wage service workers, also, holding 18 percent of all service jobs. Specifically, 23 percent of private household workers and 23 percent of cleaning service workers are black. Finally, blacks are also overly represented in manufacturing jobs at risk in the new economy, with 18 percent of operator, fabricator, and laborer jobs (Silvestri and Lukasiewicz, 1989, p. 64).

Yet blacks are positioned well in some occupational areas that will survive and provide career ladders in the new economy. Blacks make up 14 percent of technicians and technologists in health care, 28 percent of health care workers in general, and 14 percent of the nation's computer operators.

Hispanics made up 7.4 percent of the workforce in 1988 but had only 4 percent of managerial jobs, 3 percent of professional jobs, and 4 percent of technician jobs. At the same time, Hispanics made up 10 percent of the nation's service workers, having the highest concentrations in low-wage food, cleaning, and private household services. Also, Hispanics have an inordinate share of low-wage agricultural jobs (13 percent) and, like blacks, are overly represented in operator and laborer jobs at risk in manufacturing. Yet Hispanics, too, are positioned well in some areas that are likely to grow and prosper. Hispanics represent 5 percent of engineering and scientific technicians; 5 percent of marketing and sales workers; 6 percent of computer operators; and 8 percent of mechanics, installers, and repairers.

Job Security: Shifting Loyalties from Employers to Skill

The characteristic signature of the new economy is flexibility. The fast pace of change within networks and the volatility of markets, especially global markets, require flexible responses. Flexible institutions need flexible workforces. Most employers have reacted by building a workforce in layers: a core workforce with permanent status and a peripheral workforce of part-timers, temporaries, consultants, and suppliers who are accorded varying degrees of commitment. Employers utilize this peripheral workforce for varying purposes: to manage changing workloads, to save money on benefits and other costs associated with full-time employees, and to access expertise not available in-house. About one in ten American workers is now in the peripheral workforce (Abraham, 1988, p. 32). For example, the number of temporary help workers has multiplied threefold since 1978, increasing from a little more than 300,000 to a million. And temporary help agencies provide more than clerical support. As of 1982, almost half of temporaries were nonoffice workers (Abraham 1988, p. 5). The projected growth in business services reflects the increasing importance of outside suppliers. Only retail and health care will contribute more new jobs between now and the end of the century. Employment in business services will increase from 5.6 million in 1988 to 8.3 million in the year 2000.

Institutions and employees that do not seek flexibility often have it forced on them. The pace of change in the world economy and the intensification of competition can dislodge even the most secure workers. At best, a worker can hope to work for one employer for a lifetime but cannot realistically expect to hold one job all those years. In fact, although some institutions can guarantee employment in the fast-paced new economy, others, despite good intentions, cannot. Moreover, when dislocation does occur, it tends to affect whole industries, making job search particularly difficult for employees whose skills and experience are heavily invested in one job or one industry.

Perhaps there is employment security for workers at the very core of institutional networks, yet the volatility of the new economy suggests that even these workers, as well as those at the periphery of institutions, are best advised to become more loyal to their skills and less loyal to individual employers. Happily, as skill requirements become less job specific and more general, both skill and experience are becoming more transferable from one job to another. Also, as education and experience become more important in getting and keeping jobs, workers are valued less for organizational time in grade and loyalty.

Ultimately, because of the growing importance of skill and its general applicability across institutions, workers who pay attention to education, training, and work experience can increase their control over their working lives. Skill, especially accredited skill, can provide employment security in a particular industry or occupation, even if not in a particular job with a particular employer. Moreover, demography will favor workers who pay attention to skill development in school and at work. As demographic trends lead to shortages of skilled workers, especially at entry level, employers will compete aggressively for skilled workers and build stronger relationships with part-timers, temporary workers, and suppliers of business services. The trend toward more carefully integrated networks will also encourage employers to build more permanent relationships with suppliers.

The new demands for flexible employees raise some troublesome complications. First, as skills become more generalized, individual employees will be more interchangeable and the bargaining power of individual workers may decline (U.S. Congress, 1988, p. 372). The loss of bargaining power would likely be smallest among core workers and technical specialists and greatest among nontechnical generalists. Peripheral workers would be more mobile but have less bargaining power than core workers. Nurses are a case in point. They are highly skilled and highly mobile but relatively interchangeable and vastly underpaid. Second, as skill becomes more pivotal, issues surrounding access to learning arise. Postsecondary schooling is more expensive than ever, and college enrollments have flattened, especially for males. Less than 15 percent of Americans get any formal or informal training on the job (Carnevale and Gainer, 1989). Moreover, training and experience at work are not certified or recorded and are therefore difficult to prove. Finally, if we are to have a truly flexible workforce, American workers will need a whole set of expensive new benefits geared to workers on the move, including portable training, portable pensions, and portable family services like day care and parental leave.

CAREER DEVELOPMENT

Career development prospects in the new economy are a crazy quilt of possibilities. Individual prospects depend on the industry, the occupation, and managerial decisions as to how work will be organized. There are some typical patterns, however:

- ***From Bosses to Brokers.*** Managers, professionals, and business service workers will prosper. These bosses from the old economy will become brokers in the new economy, easing transactions in internal and external networks, communicating new information and learning throughout networks, and leading and developing other employees.

- ***More Technical Specialists.*** Technical specialists will do well, whether they are manufacturing engineers, health technologists, or specialized bond traders in banking. Some technical specialists (e.g., radiologists, CAD/CAM operators, and repair persons) will be attached to particular technologies. Computer and communications workers will grow in importance. Already there are as many jobs for data entry clerks in the food and health care industries as there are jobs for farmers and health care professionals (U.S. Congress, 1988, pp. 395, 398). Other technical specialties will be associated with particular product or service lines. The international bond trader is an example. In most cases, the technical specialists will substitute for less skilled labor. The manufacturing technician, for instance, works in combination with a powerful and flexible technology that substitutes for a variety of workers—including laborers, material handlers, machine operators, repair workers, and even supervisors—who, in combination, made up the work team in old line manufacturing. In services, customer service professionals armed with computer technology will substitute for a host of service personnel who used to be charged with information recording, sales, clerical functions, and final service delivery.
- ***From Craft Workers to Manufacturing Personnel.*** New jobs will be created and others restructured as networks in some industries evolve. One pattern is a shift in some industries from a preponderance of craft workers to a greater share of white-collar workers and technicians. For example, packaging and processing technologies in the food industry will eliminate local craft workers, who will be supplanted by a mix of managers, professionals, and technicians at the processing factory. Boxed beef has already stolen a march on the local butcher. A similar shift from craft to manufacturing will occur in housing construction. Houses will increasingly be designed and tailored indoors by a typical manufacturing workforce and assembled outdoors by assembly workers and craft laborers.
- ***Partitioning of Professional Jobs.*** In many cases, the stand-alone professional's job is being partitioned into a job for a team of technical specialists and paraprofessionals who work with a professional generalist. With the assistance of flexible information technologies, technicians are taking on functions previously performed by scientists and engineers. Senior bank managers are being assisted by specialized bond traders and currency experts. Paraprofessional occupations are growing in medicine and law. And in the new school, "master teachers" and apprentice teachers are joined by teachers' aides, media specialists, curriculum developers, and a host of others. The relationships among the new members of the occupational team vary. Sometimes the craft model applies. For example, the apprentice teacher can one day become the master teacher. More often than not, the generalist has the biggest pay check and the senior role, but in other cases, the relationships are ambiguous. The bond trader often makes more money than the bank president, for instance. ▪

- ***More Lateral Entry.*** The growing importance of learning, especially schooling, has resulted in a multiplication of the lateral ports of entry into institutions. As skill requirements become more generalized and skills become more transferable, employees with the same education and experience become more interchangeable between institutions. Managers, service workers, and nontechnical professionals are gaining mobility, but the skills of technical workers and other specialists are even more transferable. For instance, bank managers may have some difficulty transferring from one bank to another because much of a bank manager's experience and learning on the job are peculiar to the culture and competitive niche of the bank. Data processing experts and specialized bond traders can move more easily from one institution to another because their experience and learning on the job are attached more to products or technologies than to the institutions in which they work.

- ***Shortened Career Ladders.*** The increasing salability of education and experience in the new economy is also shortening career ladders (Noyelle, 1989). A person cannot start out in the mail room and end up as a technician, bond trader, or senior manager because career ladders are tightly tied to education and the experience it leverages. To advance in an industry or occupation, a worker must acquire the credential necessary to get the job. Once on the job, experience leverages the individual up the career ladder. The shortening of career ladders has important implications for employers and employees. Employers who want to bring their own employees up through the ranks need to make substantial investments in education and build strong linkages with educational institutions (Bailey, 1988a). And workers who want upward mobility need to know that hard work is not enough; upward mobility requires educational investments.

- ***The Convergence of Worklife***. As technology takes on repetitive physical and mental tasks, employers have an increasing amount of discretion in combining tasks into jobs. If employers choose to do so, they can continue mass production techniques, rationalizing jobs into ever more discrete tasks and utilizing traditional occupational hierarchies and information technologies to monitor the work of production and service workers down the line. Because the new technology allows geographically dispersed networks, employers can use cheap, unskilled labor pools for repetitive work while reserving more critical functions for central offices. This "respacialization" of work segregates good and bad jobs geographically (Baran and Parsons, 1986, p. 61).

For markets that demand highly standardized products or routine services, specialized hierarchies and information technologies for electronic monitoring may be appropriate. But the sale of routine services and standardized products is declining as demands for variety, customization, convenience, and higher quality increase. Moreover, organizing work in mass production formats reduces the flexibility necessary to adapt and survive in the fast-paced new economy. Often, the urge to specialize work is a throwback to the simpleminded competitive standards of the old economy and can be self-defeating. The separation of clerical, analytic, and customer service functions is a case in point. Jobs can be upgraded by combining in a single job the tasks of entering customer information, analyzing the information, and tailoring the product or service. Moreover, combining functions in a single job improves customer service, decreases response time, encourages organizational learning, and generally brings the entire competitive network closer to the customer.

Job responsibilities are becoming more generalized and overlapping. Employees are spending more time interacting with colleagues and customers. Employees and work teams in top-down hierarchies are becoming more autonomous, yet professionals and entrepreneurs are integrated into more tightly knit networks. The emerging result is an overall convergence of job structures that offer both more individual discretion and greater interdependence.

SKILL AND THE NEW ECONOMY

PART VI

The new economy will have profound implications for the way we will use people on the job. New competitive requirements will require new job designs, new organizational structures, and more skilled workers. New flexible technologies will change skill requirements and the context in which skills are used at work. Ultimately, a whole new set of skills will be required, and they will be both deeper and broader than currently required skills. This section discusses some of the factors affecting skill requirements and then elaborates on the skills needed in the new economy.

Skill and the New Competitive Framework

Employees need to be flexible in order to live with the ambiguity that inheres in the new competitive framework. Every organization has to find its unique strategic balance of competitive standards, and ambiguity results from the fact that the chosen strategy can seem to be internally inconsistent. For instance, at times, the pursuit of productivity and timeliness can seem to be at odds with the simultaneous pursuit of quality, variety, customization, and convenience.

The competencies, knowledge, and skills required of employees depend on the mix of competitive standards the organization has embraced. At the same time, however, every organization needs to pay attention, to some degree, to each of the new competitive standards. For instance, every organization has to focus on the skill requirements necessary to achieve productivity increases. In the old economy, productivity was generally achieved by automating and instituting rigid control of work processes. Using more machinery meant fewer workers were needed, and rigid machinery and work processes reduced skill requirements. These changes drove down personnel costs, which increased the value of output relative to input costs, thereby increasing productivity. The pursuit of productivity was a matter of simple arithmetic. But a productivity strategy based on deskilling work and reducing personnel costs won't work in the new economy. New, more flexible technologies and organizational formats require more flexible and skilled employees. Moreover, automating and deskilling work reduces the organization's ability to deliver on other competitive standards. In the new economy, the simultaneous pursuit of productivity and other competitive standards requires that people be treated as assets to be developed in order to add value, rather than as costs to be reduced. Employees capable of improving quality require a solid grounding in the hard competencies and job knowledge, but the softer skills are equally important. Well-prepared people can do shoddy work or allow shoddy work to go on around them. Ultimately, quality depends on the way people use their basic and technical competencies and job knowledge and the way they interact with one another. High quality begins when people take responsibility for more than their work effort in their assigned responsibilities. They must accept responsibility for the product or service before it arrives at the work station and after it moves on in the work process. As a result, the keys to high quality are personal management skills, such as the ability to achieve self-esteem by setting personal goals and motivating oneself, as well as skills for influencing, communicating with, and working with others upstream and downstream in the production process.

New standards for variety, customization, convenience, and timeliness require, above all, flexibility. To customize products and services and provide convenience for customers, workers need both the softer communications and personal skills necessary to interact effectively with customers and the adaptability and influencing skills necessary to bend the organization to the customers' demands.

The Roles of People and Machines

Changing skill requirements in the new economy are also driven by changes in technology. The impact of technology on skill requirements is best understood by analyzing human-machine combinations on the job. There are many facets to the relationship between people and machines at work, and various typologies exist to assess these different dimensions (Baran and Parsons, 1986; Blackburn, Coombs, and Green, 1985). The most useful one has been constructed by R. M. Bell, an engineer writing for the British Engineering Industry Training Board in 1972 (Bell, 1983). In his study of the metalworking industry, Bell concluded that every work activity is composed of three different work processes: *transformation*, the changing of shapes or states of raw materials or work pieces; *transfer*, the flow or movement of materials or work pieces from one part of the production system to another; and *control*, the responsibility for and physical control over the transformation and transfer functions. Each of these three work processes may be automated to a different degree.

Bell's model for describing the impact of technology on work is most relevant to manufacturing and extractive industries, but it has broader applicability. A parallel typology can be constructed for service industries. In such a typology, the three work processes are *performance*, the act of providing the service; *delivery*, the process of organizing the service and getting it to the client; and, the responsibility for and physical control over performance and delivery.

In the context of Bell's model, the history of human-machine combinations is characterized by two complementary trends:

- a sequential extension of machine capabilities, first in the transformation of material, then in the transfer of material between work stations, and finally in the control of the transformation and transfer functions, and
- an often overlooked complementary extension of the complexity and scope of the human role in economic activity.

In the craft economy, technology was subordinate to the worker in all aspects of the human-machine relationship. The processes of transformation, transfer, and control were unified in the worker. The transition from crafts to early manufacturing in the late eighteenth century to the middle of the nineteenth century took place as individual workers in cottage industries began substituting machines for tools in the transformation process. In the early days of industrialism, the transfer and control functions were still in the hands of people, usually working cooperatively in small groups (Blackburn, Coombs, and Green, 1985, p. 34). As energy sources progressed from water to steam and then to internal combustion and electricity, machine power was increasingly used for functions like lifting, cutting, and grinding, further substituting mechanical apparatus for human strength and dexterity in the transformation of material.

Eventually, as the mechanization of manufacturing matured, the new energy sources and the more powerful machines they drove increased the speed of operation and the volume of output at individual work stations, creating bottlenecks in the flow of materials and parts. As a result, mechanization of the transfer of parts and materials between manufacturing work stations became the focus of technological innovation as well as the principal driving force in design of organizations and jobs from the midnineteenth through the midtwentieth century.

In the modern manufacturing era, the relative importance of technology and people in the transformation, transfer, and control functions at work varies widely. In manufacturing, for instance, managers and professionals utilize relatively little technology, and technical professionals use only general-purpose technologies. This independence from technology is linked to independence from organization and job design. In contrast, production and other nonsupervisory workers use more specialized technology to transform and transfer material goods, and have less autonomy. Technology and the white-collar and technical elites exercise control over other employees working through carefully designed hierarchies and work rules.

The penetration of technology in service work has evolved more slowly. The service sector grew rapidly along with industrialization, but it proved difficult to mechanize the performance of services, and even more difficult to mechanize delivery and control. New tools and job aids improved performance, but the rationalization of service work has been achieved less by mechanization than by adopting organizational and managerial practices from the more technology-intensive sectors.

Because service functions are difficult to automate, nonsupervisory workers in services are less subservient to technology, organizational structures, and job designs in the performance and control functions than are manufacturing workers. Yet at the same time, the basic differences between supervisory and nonsupervisory workers in manufacturing are mirrored in service delivery: White-collar elites are relatively independent of organizational structure and restrictive job designs, and nonsupervisory workers tend to work with more job-specific technologies and are more constrained by organizational structure and careful job design.

The Changing Complexity and Scope of Skill

In recent years, we have needed to make a qualitative leap in use of human-machine combinations at work in order to satisfy new competitive standards. As a result, technology has supplanted the human partner in some tasks. For example, in manufacturing, programmable machines have superseded human skill in many aspects of transformation of materials. The skilled machinist and tool and die maker are being replaced by computer-based machinery because the new technologies improve precision and thereby improve quality. Also, the new information technologies allow faster setup and reprogramming and thereby encourage timeliness, variety, and customization. In addition, information technologies have revolutionized the transfer of parts and materials, allowing just-in-time production. Information technologies have also improved control functions because of the programmability of information networks as well as their ability to monitor performance and communicate both within the organization and with suppliers and customers.

The role of technology has also expanded in service industries. In some cases, such as long-distance calling and the automated teller machine, the new technology has almost completely automated performance, delivery, and control.

The broadened scope of economic activity is expanding the roles and demanding more of both machines and people in manufacturing and services. While technologies, especially information-based technologies, have expanded the technical role in all aspects of economic activity, the human partner has taken on higher-order control functions necessary to deploy new technologies effectively and operate in a more complex work environment.

Therefore, the advance of technology in the new economy does not necessarily represent a growing dominance of machines at work. Substantial evidence to the contrary shows a growing preponderance of high-skill jobs in the economy as a whole, as well as increasing skill requirements in existing jobs (Johnston and Lawrence, 1988; Spenner, 1985; Kutscher, 1989; Baran and Parsons, 1986).

In part, confusion over the impacts of new technologies at work stems from our inability to understand the dynamics of skill change. The combination of human and machine capital is not a "zero-sum game," in which winners can gain only at the expense of losers. Jobs are not fixed sets of tasks to be divided among machines and people. Both the complexity and the scope of jobs change over time. An expanded technical role in economic activity does not necessarily signal a reduction in human contributions. Instead, when the complexity of work is increasing, as it is now, a commensurate increase in the quality of both technical and human elements is usually required. In theory, the advance of information technologies permits employer institutions to operate effectively with small elite corps of white-collar and technical employees and even smaller groups of workers who have been reduced to passive machine tenders monitored by video surveillance and computers. Such a strategy can speed up production or service delivery and reduce costs, thereby increasing productivity, and is consistent with the market demands and organizational structures of mass production. However, there is growing evidence that this strategy does not exploit technical potential fully and is inappropriate to the new competitive requirements (Adler, 1988; Hirschhorn, 1988).

Typing pools and other kinds of electronic sweatshops are examples of inappropriate use of the new technology in services. In manufacturing, the recent introduction of numerically controlled machine tools is a particularly instructive case in point. Numerically controlled machine tools were originally sold as labor-saving substitutes for mass production technologies to increase productivity and save on labor costs. Employers have since discovered that having more skilled labor use these tools more flexibly increases the ability to provide high-quality, small-batch, varied, and tailored products and eventually improves productivity, quality, speed, and convenience (Piore and Sabel, 1984, p. 54; Adler, 1988, p. 9).

The dynamic of automation is entirely different in the new economy than in mass production. Employers wedded to old habits of mind are tempted to deploy the new technology to reduce labor costs, not realizing the importance of the new competitive standards. These employers are competing in the old economy, not the new one in which flexible technologies are raising the ante on general skill requirements. Generally, the new automation eliminates or subsumes repetitive intellectual tasks in much the same way previous mechanization eliminated or took over repetitive physical tasks. For every task surrendered, however, there are new responsibilities generated for exploiting the flexible capabilities of the technology. Moreover, the more flexible and powerful the machinery, the more employees, work teams, and organizations must increase their skills to deploy it.

Of course, not all employees benefit from the new technology. Some existing tasks and responsibilities are eliminated, some are subsumed, and others are added. Typically, technical change in manufacturing has harmed middle-aged machine operators in the Midwest and has helped younger technicians and service personnel in trade-sensitive coastal economies. In services, the new technology has reduced opportunities for office personnel who record, store, update, and transmit information and increased opportunities for front-office service workers. Moreover, the progress of technical change is rarely smooth. Partial automation can create low-skilled jobs that offer little opportunity for upward mobility while they last, and little transferable human capital when they are eliminated. For instance, the partial automation of phone service has reduced skill requirements for operators and increased electronic monitoring of their work.

Our inability to fully appreciate and respond to the skill requirements of new technologies in the new economy is compounded by our limited definitions of skill. Skill is not a homogeneous commodity. Work skills can be sorted loosely into two broad categories: skills related to technical complexity and skills related to scope of action.

TECHNICAL COMPLEXITY

Skills associated with the technical complexity of work are the hard bits of knowledge and physical movements necessary to perform specific tasks. These skills include cognitive information—remembered and applied—like the carpenter's knowledge of fractions and the hand-to-eye coordination necessary for sawing straight lines. The more the knowledge and physical talent are applied, the more they are transformed from pure cognition to know-how, or expertise. The machinist, for instance, combines a basic knowledge of computation and hand-to-eye coordination, deepening these skills over long periods of time until achieving the expert status of tool and die maker.

Skills associated with technical complexity are those most immediately affected by automation. The mass production economy reduced dexterity to simple physical movements to be mimicked by machines. Information technology goes a step further, reducing repetitive thought processes or branching logic to software. In the new economy, the role of technology is increasing in a broad array of jobs. At the same time, however, the new economy seems to be demanding a higher level of technical complexity in the human role in a growing proportion of jobs. For instance, in the traditional mass production workplace, the machinist had to have depth of skill, principally in hand-to-eye coordination. In the manufacturing workplace of the new economy, the technician who substitutes for the machinist needs skills with much greater technical complexity. The modern manufacturing technician also needs deeper reading and writing skills in order to learn and communicate in an environment where the pace of change is faster, products are more varied, and there is a premium on speedy innovation and response times. The modern technician also needs deeper math skills than the traditional machinist in order to work with flexible technologies whose operations are based on arithmetic and branching logic, as well as to monitor quality of output using mathematically based readouts.

Some increases in the technical complexity of human work result from learning requirements peculiar to particular employer institutions. Each employer's technologies, human-machine combinations, and products are unique. Technical changes resulting in new work processes and procedures require constant updating of employer-specific technical knowledge. Variety in a product requires greatly expanded product knowledge. The proliferation of computer-based technology also increases the need for understanding in-house software.

SCOPE OF ACTION

The scope of action in a job is indicated by the range of activities involved in getting the job done effectively. By way of contrast, technical complexity in a job generally requires greater depth of skill, whereas expanding scope of action in a job requires greater breadth of skill. To continue the previous example, new, more powerful technologies have assumed repetitive physical and intellectual tasks, and the manufacturing technician has assumed an expanded scope of responsibility for productivity, quality, and speed not only at his or her assigned work station but also upstream and downstream in the work process. The technician has also assumed responsibility for deploying the technology flexibly to produce a greater variety and more tailored set of products. To manage the greater scope of action on the job, the technician needs broader skills than the machinist. For instance, to operate beyond his or her work station, the technician needs a new set of interpersonal and organizational skills. To cope with change and variety, the technician needs learning and problem-solving skills.

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The human scope of action which can expand or contract as a result of technical change, can usually be measured by the extent to which a job unifies the design, execution, and control of the work. Scope of action was extensive in the jobs of the craft economy. In the mass production economy, scope of action was extensive for white-collar and technical elites but not for workers down the line. The mass production economy shattered the unity of work for the sake of efficiency. In the new economy, scope of action is expanded in order to exploit more flexible technologies and satisfy more intense and expanding competitive requirements. The unity of design, execution, and control is returning.

The Changing Dimensions of Skill in the New Economy

Depth and breadth are not the only dimensions of skill that are changing. For instance, the context for using skill is changing. Skills in the emerging economy are increasingly peripheral to hands-on work. Moreover, the context for using skill is shifting from repetitive applications to more sporadic and exceptional uses. In addition, the content of skill requirements is shifting from job-specific to more general capabilities, from "harder" concrete skills to "softer" more abstract skills, and from objective capabilities to more personal skills. Finally, skill requirements are beginning to converge as they become less job specific and are utilized in more fluid contexts. More and more of us spend our time at work doing the same sorts of things.

FROM HANDS-ON TO HANDS-OFF

As technology subsumes more and more of the hands-on and repetitive aspects of work, human labor becomes more peripheral to the actual fabrication of goods and delivery of services. In manufacturing, for instance, our traditional team on the factory floor included a machinist, maintenance person, laborer, materials handler, assembler, and supervisor. Each of these workers had a direct hands-on relationship with products and materials as they moved through the production process. The machinist transformed the shapes or states of materials or parts. The maintenance person adjusted and maintained the machinery by manipulating its parts. The laborer and materials handler transferred work pieces or materials from work site to work site. The assembler put pieces of products together. The supervisor monitored the work flow, balancing output at sequential work stations to avoid bottlenecks.

Today a single technician who works with more powerful automated technology can replace all these employees. The technician works through control boards and software in a hands-off relationship with the product. He or she programs and maintains information-based technologies that have subsumed all the other hands-on tasks of the old working team, with the possible exception of maintenance.

As technology subsumes hands-on tasks, manufacturing institutions shed direct labor. Fewer employees are involved in hands-on production, but more are dedicated to service functions peripheral to the production process. The challenge to manufacturing skill in the new economy is not so much to make the widget but to make it with quality and variety, to tailor it for the consumer, to deliver state-of-the-art versions of the widget fast and conveniently in a complex global economy, and to win the race up the learning curve to improve the widget. The labor and skill involved in these processes have less and less to do with hands-on production.

The peripheralization of labor is also characteristic of services in the new economy. Labor-intensive tasks associated with collecting, recording, analyzing, and communicating information are increasingly subsumed in information-based or communications technology. As a result, service employees spend more time face-to-face with co-workers or clients, designing and performing an expanded variety of services that are tailored to clients' needs and delivered conveniently.

The banking industry is a good example. In the bank of the 1950s, most of the human capital was utilized to collect, analyze, and process information. Frontline personnel, principally tellers, were passive ciphers who passed customer information back to mainframe data processing centers. A complex hierarchy of administrative control and work rules ensured the integrity of financial information and bank services. At the middle and top of the hierarchy were bank officers. The officers sifted and assessed financial information to make deliberate and responsible decisions. Face-to-face customization of services was rare, apart from the essentially passive role of the tellers, and was provided by officers located only in the middle and upper ranges of the bank hierarchy.

In the financial services institutions of the new economy, in contrast, frontline personnel armed with the new information and communications technology work face-to-face with customers to fashion tailored financial service packages. The central collection, recording, analysis, and communication of financial information that so preoccupied the bank of the 1950s has changed radically. Information technology has been "distributed" throughout the organization. The traditional flow of information from the customer to the backroom data processing operation and up the organizational hierarchy has been deemphasized. Instead, a shared information network moves information to the interface with the customer or other operational pressure points as necessary. The bank's varied products and services have been incorporated in user-friendly software that is invisible to the financial services worker and customer, who work together to tailor offerings to the customer's specific needs.

FROM SPECIFIC TO GENERAL SKILLS

As the new technology automates the tedious and repetitive physical and mental tasks in every job and work becomes more peipheral to hands-on functions, skill requirements become less job specific and more general. For instance, at the most personal level, the ability to adapt to a changing variety of products and situations requires self-possession born of self-esteem and the ability to set goals and motivate oneself to achieve them. Flexibility in the varied and changing environments of the new economy also requires a solid foundation in reading, writing, and computational skills, as well as the capacity to learn, solve problems, and be creative. Expanded scope of action on the job requires the ability to juggle a variety of responsibilities and tasks.

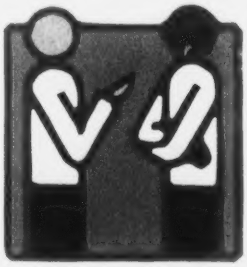
Organizational formats typical of the new economy also require general skills. The substitution of flexible networks for top-down hierarchies means employees need interpersonal skills to get along with customers and co-workers; listening and oral communications skills to ensure effective interaction; negotiation and teamwork skills to be effective members of working groups; leadership skills to take charge when needed to move work teams forward; and organizational skills to utilize effectively the work processes, procedures, and culture of the employer institution (Carnevale, Gainer, and Meltzer, 1989; Carnevale, Gainer, and Meltzer, 1990). More flexible organizational formats in combination with more powerful and flexible technologies also grant individual employees greater autonomy at work. Employees need sufficient self-management, goal-setting, and motivational skills to handle this new autonomy.

The more flexible organizational formats also tend to reduce job security. At best, employers can guarantee employment security but not job security. At worst, employees will be forced to change employers and jobs frequently throughout their careers. As a result, employees need the general skills necessary to move among jobs and to take responsibility for their own personal and career development.

FROM THE CONCRETE TO THE ABSTRACT

Skill requirements are also shifting from the concrete to the abstract (Bailey, 1988a, pp. 22-23; Adler, 1988, p. 18; Zuboff, 1988). Increasingly, jobs require that workers spend more time sitting in front of computer screens wrestling with abstractions or interacting with colleagues, suppliers, or customers.

As scope of responsibility expands and work becomes more hands-off, the individual worker must be able to conceptualize products and services and understand the impact of his or her work on production and service processes. In such an environment, physical tasks become mental tasks and thinking becomes procedural. As work becomes more abstract, higher-order conceptual skills become more important, as do communications skills for making the abstract more concrete.



GETTING PERSONAL

In the mass market economy, employees were largely responsible for their own work effort and the technical quality of their own output. In the new economy, human responsibilities have been reintegrated at higher levels: Individual workers are responsible for the integrity of whole work processes and final products and services (Adler, 1988). Employees in the new economy need specialized competencies, but also more holistic skills such as self-management and interpersonal skills.

In the new economy, jobs are more social. The decline of hierarchy and the growing importance of informal networks, the substitution of continuous processes and shared information for sequential work processes, the increasing overlap of roles and work assignments, and the increasing interaction with co-workers and customers all increase the importance of social interaction at work. Like craft workers, employees in the new economy are concerned with broad aspects or the totality of the work process. But unlike autonomous craft workers, employees in the new economy are members of working teams. Both the shoemaker and the computer programmer have deep technical skills, but the context in which they operate is entirely different. For the computer programmer and a growing share of workers, work is a collective process. Each individual's effort has a reciprocal effect on the efforts of others. In tightly integrated just-in-time manufacturing or extractive industries, one technician's mistake can affect all other workers. In service functions, incorrect data entry by one employee pollutes the data base for everybody else.

As employees become more interdependent, the softer social skills become more important. The technical knowledge necessary to perform a task must be accompanied by the more complex capability for playing roles in the context of a group. The fundamental social skill is the ability to manage oneself. Self-esteem is the taproot to effective management, and self-loathing is the most fundamental impediment to successful interaction with others. Self-awareness is also critical to self-management. Employees need to understand their limits, ability to cope, and impact on others. The ability to set goals and motivate oneself to achieve is critical to being a team member; lack of motivation or goal-setting skills can create an undercurrent that can undermine team accomplishments.

As the frequency of personal interaction with co-workers and customers increases, the ability to communicate also becomes crucial: Employees must be able to listen and express themselves orally and in writing. If individuals are to be effective in groups, they need good interpersonal, negotiation, and teamwork skills. Interpersonal skills include the ability to judge the appropriateness of behavior and to cope with undesirable behavior, stress, and ambiguity. Negotiation skills are necessary to manage and defuse potentially harmful disagreements. Teamwork skills include the ability to cope with and understand the value in different work styles, cultures, and personalities of team members and to provide and accept feedback constructively.

As work becomes more of a social process, the ability to influence co-workers also becomes more important. Influencing skills include both organizational effectiveness and leadership skills. Each organization is a tapestry of implicit and explicit power structures. To be effective inside the organization, the employee needs to understand both. Without this understanding, leadership skills are misplaced; they can even be counterproductive if they end up as barriers to strategic organizational goals or positive change processes. At its most elementary level, leadership means the ability to influence other people. As group processes increase in importance, leadership skills become critical for every employee from the chief executive to the line worker.

FROM REPETITION TO HANDLING EXCEPTIONS

Because the reach of technology is subsuming repetitive work functions, human capital is used more and more to handle exceptions to routine production and service delivery. People are called upon less often, but the technical complexity of the required work can be very deep. For this reason, and because of the expanded scope of action characteristic of work in the new economy, people require a reservoir of deep skill to be called upon for sporadic application in exceptional circumstances. Like the sentry, the employee in the new economy uses deep skills rarely, but the consequences are disastrous if the skills aren't there when needed. For example, the modern manufacturing technician in combination with more powerful and flexible technology replaces as many as four other employees who used to make up the old assembly-line shop-floor team in low-tech manufacturing—the machinist, materials handler, maintenance person, and supervisor. The technology actually performs most of the tasks, but the technician is responsible for deploying, monitoring, and problem solving when necessary. As a result, the technician requires a greater breadth and depth of skill than the traditional manufacturing employee whose work was more consistent and repetitive.

Our white-collar and technical elites have always been required to have reserve skills that are deeper and broader than everyday skills. Amply educated and assigned to jobs that demand competence in a constantly changing variety of situations, they learn to juggle changing assignments, adapt to changing demands, and tailor actions to the specifics of the situation at hand. Managers neither hire nor fire very often, but they need to be able to perform these functions flexibly and competently. Technical elites are not asked for new ideas very often, but they need a reservoir of skill to call on when creative leaps are required. The critical difference in the new economy is that both our elites and our nonsupervisory workers need a reservoir of skills that are deeper and broader than usually required on the job.

The industrial worker, for instance, often spends long periods of time monitoring abstract representations of work processes on computer screens or electronic control boards. Yet the industrial sentry is asked to do much more than stand, watch, and wait. He or she needs sufficient reserve skill to adapt to technical and work process changes, recognize and respond to anomalies, maintain and repair the equipment, and occasionally reprogram technologies to produce variety and customize products. Moreover, the industrial sentry needs to be alert and able to capture quality and efficiency improvements and develop new applications.

Service workers, like industrial workers, need robust reserve skills in order to cope with change, tailor service, handle exceptions, and capture new learning on the job. They also need to interact closely with customers. For instance, it is relatively simple to operate a cash register, but providing good customer service requires more. In the financial, real estate, and insurance markets, every customer is an exception to the rule when marketing, selling, and packaging. Similarly, education workers must respond to students' different learning styles, and health care workers treat unique medical problems.

What do employees need in their bag of reserve skills to handle a growing stream of unprecedented situations at work? First, they need the intellectual and emotional flexibility necessary to adapt to change and dissimilar situations. Central to flexibility is the ability to learn—to keep up with change, to know what needs to be learned, and to learn it without disrupting performance. Second, because of constantly changing situations, employees must be able to cope with ambiguity. Finally, the ability to solve problems and creativity also are important because skills are constantly being challenged in novel situations (Carnevale, Gainer, and Meltzer, 1989).

SKILL CONVERGENCE

In the new economy, both jobs and their skill requirements are becoming more alike. As the preceding discussion indicates, there is a trend for required skills to be hands-off, general, abstract, personal in content, and applied in the context of groups and unique situations. In addition, the expansion in service functions in manufacturing and natural resource industries, in combination with the increasing dominance of the service sector, ensures that a growing proportion of us need the broad, abstract, flexible skills typically required in service jobs.

Skill convergence is driven from the top down and the bottom up. There is a compression of skill as supervisors, managers, and technical personnel surrender autonomy to nonsupervisory workers and as nonsupervisory employees take on more general assignments. The need to provide tailored goods and services conveniently and design and install incremental improvements and new applications drives elite managerial and technical functions down the line, because frontline workers are best situated to perform these functions. The convergence of skill is being driven from the bottom up as well. The more flexible and powerful technologies free up nonsupervisory labor for more general responsibilities. In addition, in order to take advantage of these technologies, employers are developing more flexible work processes, resulting in further increases in autonomy down the line.

How to Read This Chart: Independence at work varies greatly among the typical types of work organizations. In the preindustrial craft economy, the artisan was autonomous. In modern mass production and service delivery structures, all employees depend on their status in the organizational hierarchy for their relative independence on the job. In mass production structures, white-collar and technical elites have the most discretion because of their broad assignments. Skilled trade employers also have considerable discretion in mass production but only within their technical domain. Blue-collar production employees have the narrowest task assignments and the least discretion. Service structures are similar to manufacturing. White-collar and technical elites in service organizations enjoy relatively more discretion than nonsupervisory service workers. At the same time, however, nonsupervisory employees in services enjoy more independence than blue-collar production workers because it is inherently more difficult to standardize service work. Workers in the independent sector enjoy considerable discretion at work. They are often self-employed or work in organizations sufficiently small so that job assignments are broad. In the new economy, there is a convergence of work settings toward integrated networks of people, work teams, and organizations. Networks in the new economy increase the interdependence of all people at work while allowing more independence for individuals and work teams.

FIGURE 2 Characteristics of People at Work in Typical Production and Service Delivery Systems

Characteristics	Typical Production and Service Delivery Systems							
	Pre-Industrial Crafts	Mass Production			Services		Independent Sector	The New Economy
Typical Workers	Artisans	White-Collar Workers, and Technical Professionals	Skilled Trades People	Blue-Collar Production Employees	White-Collar Workers, and Service Professionals	Nonsupervisory Employees	Small Business Crafts and Professional Workers	Teams Made Up of Individuals Alternating Expert, Brokering, and Leadership Roles
Independence at Work	Autonomous, Self-Employed	Discretion Dependent on Assignment in Organizational Hierarchies					Independent and Often Self-Employed	Individuals and Work Teams Autonomous but Mutually Dependent in Networks
		Broadly Assigned	Broadly Assigned in Technical Domain	Narrowly Assigned to Specific Tasks	Broadly Assigned	Narrowly Assigned		
Source of Rewards	Membership in the Guild Community	Time and Grade in Job Assignment					Certification and Entrepreneurial Ability	Performance of Teams and Networks
Source of Job Security	Membership in the Guild	Longevity with a Particular Employer in a Particular Job Category					Certification and Entrepreneurial Ability	Skills, Experience, and Career Development
Skill Requirements	Deep Occupational Skills	Deep Occupational Skills, as well as Broad Group Effectiveness, Adaptability, and Organizational Skills	Deep Technical Skills and Problem Solving	Narrow Job Specific Skills	Broad Adaptability, Interpersonal, and Organizational Skills	Narrow Job Specific Skills and Interpersonal Skills	Deep Occupational Skill, Personal Management, and Adaptability Skills	Deep Technical Skills, as well as Learning, Communication, Adaptability, Personal Management, Group Effectiveness, and Influencing Skills
Using Skills at Work	Hands-on/ Concrete, Specific, Repetitive	Hands-off/ Abstract; Reserves of Technical and Non-technical Skills Required for Handling Exceptions	Hands-on/ Concrete, Reserves of Technical Skills Required to Handle Exceptions	Hands-on/ Concrete, Job Specific, Repetitive	Hands-off/ Abstract; Broad and Deep Reserve Skills Required	Hands-on/ Concrete, Job Specific, Repetitive	A Mix of Hands-on and Hands-off Skills Required, as well as Reserve Skills to Handle Exceptions	Hands-off and Abstract; General Skills, Both Technical and Non-technical Skills in Reserve to Handle a Continuous Flow of Exceptions

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Basic Workplace Skills

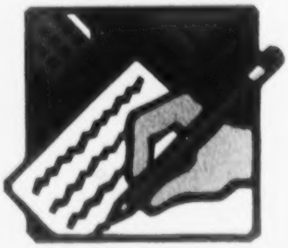
The discussion thus far has enumerated a variety of skills required of workers in the new economy. This section discusses these skills one by one. In each case, skill is defined and the following questions are answered:

- Why is the skill important in the new economy?
- What is the curriculum?
- What constitutes competency?

The Academic Basics: Reading, Writing, and Computation

THE ACADEMIC BASICS: READING

Reading skills needed for work are developed on three levels: (1) basic literacy—the ability to decode and comprehend written material; (2) reading-to-do—the ability to utilize basic reading skills, short-term memory, and information processing to locate printed information for immediate use; and (3) reading-to-learn and reading-to-do—the ability to use basic literacy skills in conjunction with long-term memory and writing, computation, learning, adaptability, and job-specific skills in order to decode, problem solve, or troubleshoot.



Why is Reading Important in the New Economy? On average, American workers spend from 1.5 to 2 hours every working day reading forms, charts, manuals, electronic display screens, and general literature. In the new economy, reading skill requirements will increase and deepen because the growing complexity and scale of global economic activity will require more written communication. Also, the expanding reach and complexity of electronic and organizational networks will require more reading to stay in touch. Better reading skills will be needed to stay abreast of change, foster incremental improvements, and accelerate innovation. In addition, the infusion of information technologies will require more reading from operating and repair manuals and electronic screens.

What Is the Curriculum? A curriculum for reading on the job should be specific to the workplace in which the reading skill will be used. Successful workplace curriculums should:

- develop basic literacy skills such as recognizing and understanding common job-related words as well as comprehending sentences and paragraphs;
- develop reading-to-do skills such as identifying details and specific actions in context, locating relevant information in context, and using charts, diagrams, and schematics; and
- develop reading-to-learn skills such as synthesizing written information from several sources and inferring meaning from texts that do not explicitly provide the required information.

What Constitutes Competency? Every American needs to read at a fourth-grade level in order to decode the simplest written information, such as warning and traffic signs. Reading skill beyond the fourth-grade level provides improvements in comprehension and expands the number of words that the reader can decode. The fifth-grade reading level is the minimum necessary to qualify for military service. However, substantial evidence suggests that a fifth-grade reading level is less than adequate for work.

About one-third of American workers—frontline employees working at the point of production and service delivery and at the interface with customers, machine operators, and service workers—require reading skills at the eighth-grade level to comprehend work orders, forms, and manuals.

Another third—skilled workers, craft workers, manufacturing technicians, health care technologists (e.g., radiologists), secretaries, and computer programmers—require reading skill beyond the eighth-grade level, probably at the average level of people with two years of postsecondary education. These workers need to be able to master complex manuals and other materials associated with their responsibilities at work and necessary to keep up in their areas of technical expertise.

Another third of American workers—professionals, managers, and scientists—require reading skill at the college-graduate level. These elite employees require a higher level of reading competency in order to stay abreast of changing professional and technical information.

In all cases, individuals must be able to apply reading skills in the context of a task or job responsibility; competency is measured by performance of a task rather than by direct tests of reading ability. At work, people decode forms, phrases, and abbreviated technical language, not the fully developed information they learned to read at school. Comprehension at work requires the ability to understand written cues. Therefore, standards for reading skills at work need to be set after assessing the context in which these skills are to be applied. Evidence shows that individuals in performance-and competency-based instructional formats achieve mastery when they demonstrate correct performance 75 percent to 80 percent of the time.

THE ACADEMIC BASICS: WRITING AT WORK

Writing at work involves a two-stage process: (1) prewriting—topic selection, preparation, and accessing and organizing information; and (2) writing—spelling, penmanship, reading, editing, and revising.

Why is Writing Important in the New Economy? Rapid change and the growing complexity of information networks inside and outside organizations require better writing skills from a growing share of American workers. Only about 8.4 percent of the average employee's communicating time is spent writing, yet writing is most often used at critical junctures in the work process. Written communications become part of a relatively permanent information base; they are shared and used to inform and guide people inside and outside organizations over time. Inaccurate or unclear writing can pollute the shared information base and affect the quality and efficiency of work upstream and downstream.

What is the Curriculum? Work-related writing curriculums are unlike the traditional classroom approach, which focuses on creativity and full development of thoughts in essays. Curriculums for writing at work emphasize a distillation of information in formats that often ignore the academic standards for quality and grammar. Effective work-related writing curriculums should:

- develop writing skills oriented toward applications and job performance;
- conduct exercises on transferring information, such as writing key words and standardized sentences, and entering information on forms; and
- conduct exercises on recording actions and transactions, identifying the intent of the writing and understanding the reading audience, outlining sequences and structures, and providing brief, accurate, and clear descriptions.

What Constitutes Competency? The essential standards for writing at work are brevity, clarity, and accuracy. Most writing at work involves transcribing key terms and standard sentences: 42 percent involves filling out prepared forms; 25 percent requires recording, summarizing, or using language peculiar to specific occupations and jobs; 23 percent involves writing memos and letters; and only 10 percent is dedicated to writing academic-style reports and articles. Therefore, an individual's mastery of writing on the job is tied to work-related competencies.

THE ACADEMIC BASICS: COMPUTATION

There are five elements of computational skill required at work: (1) quantification—the ability to read and write numbers, put numbers in sequence, and recognize whether one number is larger or smaller than another; (2) computing—the ability to add, subtract, multiply, and divide; (3) measurement and estimation—the ability to measure time, distance, length, volume, height, weight, velocity, and speed and use such measurements; (4) quantitative comprehension—the ability to organize data into quantitative formats; and (5) quantitative problem solving—the ability to recognize and set up the problem and compute the answer.

Why is Computation Important in the New Economy? New organizational, competitive, and technical requirements at work require higher computational skill levels. Flexible and decentralized organizations and networks are becoming integrated by complex, shared information systems that rely on quantitative measures of markets, performance, and quality. Products and services are increasingly customized, requiring employees to constantly reset quantities and dimensions for production and delivery. New flexible technologies and software require mathematical skill to utilize their logically patterned capabilities fully.

What is the Curriculum? Almost 75 percent of Americans are computationally literate. Most Americans know how to quantify, compute, and measure, but can't apply what they know. As a result, workplace computational skills are best taught in an applied fashion. In school, mathematics is taught as an end in itself, as a sequence of operations from the simplest to most complex, followed by drill and practice on the mathematical operations themselves.

Tests are standardized and emphasize proficiency in separate operations. At work, computational skills focus less on the correct performance of mathematical operations and more on using math to solve problems. Curriculums should emphasize:

- selection and use of mathematical operations to solve particular work-related problems and
- contextual examples of possible job situations.

What Constitutes Competency? Although computational skills for work do not correspond neatly to academic grade equivalents, there are some rough rules of thumb. Most workers require competency in basic operations—addition, multiplication, subtraction, and division—at about the eighth-grade level. This group of workers includes managers, nontechnical professionals, health care workers, machine operators, and service workers—about 80 percent of all American workers. Another 15 percent— including technicians, technologists, and craft and data processing workers—need computational skills roughly at the level of a few years of postsecondary schooling. Another 5 percent—technical managers, accountants, engineers, economists, and other technical professionals—require computational skills at or beyond the college level.

Ultimately, grade equivalents are only clues to job-related computational skill needs. The requirements vary by occupation, although all employees should be able to organize information into quantitative formats, select appropriate computational tools, and recognize errors resulting from inappropriate use of quantitative operations.

Competency standards and assessments should be based on performance standards and reflect current and future job needs.

Learning to Learn

Knowing how to learn is the most basic of all skills because it is the key that unlocks future success. Learning to learn involves knowing the principles and methods that allow us to perform in three domains: (1) the cognitive domain of skills we use to collect, know, and comprehend information; (2) the psychomotor domain of skills we use to control our bodies in order to accomplish tasks; and (3) the affective domain of skills we use to know, understand, and respond to feelings and behaviors.

Why is Learning to Learn Important in the New Economy? Equipped with this skill, an individual can achieve competency in all other basic workplace skills. Learning skills are required in order to respond flexibly and quickly to technical and organizational change; make continuous improvements in quality, efficiency, and speed; and develop new applications for existing technologies, products, and services.

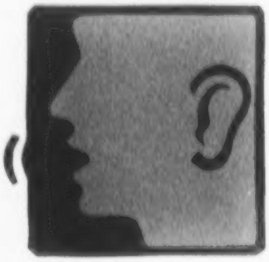
What is the Curriculum? Learning to learn curriculums include procedures for self-assessment, exposure to alternative learning styles, and training specific to the work context in which learning needs to occur. Specifically, these curriculums should:

- identify personal learning styles, capabilities, and sensory preferences (seeing, hearing, or feeling), using testing instruments such as the Meyers-Briggs Type Indicator, the Learning Styles Inventory, or the Memorize, Understand, and Do;
- develop awareness of cognitive, psychomotor, and affective learning strategies and tools; and
- match the employee's job contents and career trajectory to his or her learning needs, using instrumentation such as the Instructional Systems Design and Job Learning Analysis.

What Constitutes Competency? Competency in learning includes demonstrated ability to assess what needs to be learned, apply learning techniques, and use new learning on the job. Specifically:

- individuals must be able to conduct a learning needs assessment and demonstrate personal learning skills such as understanding their own learning styles and capabilities.
- individuals must be able to demonstrate skill in the cognitive domain by organizing, relating, recalling, and evaluating knowledge; moving from knowing to understanding and applying knowledge; understanding how to think logically, divergently, critically, and intuitively; understanding alternative learning strategies and tools; and understanding how to mobilize and organize learning resources.
- the learning process is ultimately cognitive and individual, but because learning in applied settings often involves interacting with others, individuals must have a complementary set of interpersonal learning skills, including giving and receiving feedback, learning collaboratively, and using others as learning resources.

Communication: Speaking and Listening



Why Are Communication Skills Important in the New Economy? In the new economy, workers spend most of their day engaged in some form of communication. Reading and writing are essential communication tools, but it is through listening or speaking that we interact most frequently at work. The average worker spends 8.4 percent of his or her communication time at work writing, 13.3 percent reading, 23.0 percent speaking, and 55.0 percent listening (Carnevale, Gainer, and Meltzer, 1990).

The competitive standards of the new economy require effective communication skills. For instance, to ensure high quality, employees must take responsibility for final products and services, which means they have to be able to communicate with others upstream and downstream in the work process. In addition, new standards for speed and reduced cycle time require quick and informal communication. Variety and customization require fluid communication in order to switch from one product or service design to the next. Improvements in customer service also require effective communication skills. Moreover, new organizational formats and technologies also require better communication skills. Flexible networks rely on communication in order to integrate work efforts effectively. As new technologies take on repetitive physical and intellectual tasks, employees will spend more time communicating with co-workers and customers.

Communication: Speaking Skills

Speaking skills needed for work can be broken down into three areas: (1) nonverbal skills—body language and appearance, which deliver 55 percent of the meaning in face-to-face communication; (2) vocal skills—rate, pitch, and loudness, which transmit 38 percent of the message in face-to-face communication and 70 percent to 90 percent of the message over the telephone; and (3) verbal skills—language, which transmits only 7 percent of the message, but tends to be worth more later, when the listener gets past nonverbal and vocal characteristics in the communication process.

What Is the Curriculum? The curriculum for speaking is as follows:

- build awareness of individual communication style using the Myers Introduction to Type (MITT), Performax's Personal Matrix System (PPMS), and the Communication Skills Self-Assessment Exam (CSSAE);
- learn to value different communication styles by participating in group exercises; and
- learn to adjust communication style to meet the demands of different work situations by participating in group exercises and role playing.

What Constitutes Competency? There are three areas of competence in speaking skills:

- individuals must be able to get a point across in a way that has a desired impact on others.
- individuals must be able to use available instrumentation (MITT, PPMS, CSSAE) for tracking individual progress, setting performance goals, and deepening self-awareness.
- workers must know how to obtain and use formal and informal feedback from superiors, peers, and customers as a means of measuring competence and progress.

Communication: Listening Skills

Listening skills for work involve receiving and assigning meaning to aural stimuli.

What is the Curriculum? There is a distinct curriculum for listening skills:

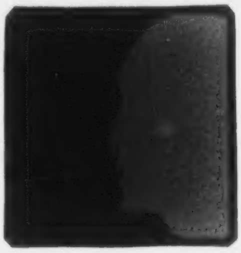
- develop awareness of alternative listening styles using the Sequential Test of Educational Progress (STEP), the Watson-Barker Listening Test (WBLT), the Attitudinal Listening Profile System (ALPS), or the CAUSE For Listening (CAUSE);
- assess individual listening style;
- learn to reduce environmental and interpersonal barriers to effective listening at work; and
- learn to listen actively.

What Constitutes Competency? Competence in listening skills can be measured as follows:

- workers should obtain formal and informal feedback from superiors, peers, and customers as a means of measuring competence and progress.
- instrumentation, including STEP, WBLT, ALPS, and CAUSE, is useful in testing awareness and skill.

Adaptability: Problem Solving and Creative Thinking

Why are Adaptability Skills Important in the New Economy? An organization's ability to overcome barriers to achieve productivity and quality improvements; to develop new applications for existing technologies, products, and services; and to manage variety and customization of products and services depends on the problem-solving and creative abilities of its employees. In addition, new flexible organizational formats require equally flexible workers and work teams capable of solving problems on their own. Moreover, as technology takes on repetitive work, workers spend more of their time using their problem-solving and creativity skills to handle exceptions to routine mental and physical tasks.



ADAPTABILITY: PROBLEM SOLVING SKILLS

Problem solving is the ability to bridge the gap between what is and what ought to be. Problem-solving skills include the ability to recognize and define problems, invent and implement solutions, and track and evaluate results.

What is the Curriculum? The curriculum for problem solving includes developing knowledge of one's own problem-solving style and capabilities, exploring alternative problem-solving styles and techniques, and learning problem-solving techniques to be used individually and in groups. A typical curriculum must do the following:

- assess individual styles using the Meyers-Briggs Type Indicator and the Herrmann Brain Dominance Instrument;
- teach how to recognize, define, and organize problems using (1) order—sequence and arrangement of things and ideas, (2) structure— connections between things and ideas, (3) relation—how things and ideas interact, (4) level—depth of focus, and (5) point of view;
- explore the thinking tools for problem solving, such as (1) deduction—moving from the general to the particular, (2) induction—moving from the particular to the general, (3) lateral thinking—thinking intuitively, (4) dialectical thinking—holding conflicting points of view, (5) unfreezing (reframing)—accepting new points of view, and (6) critical-reflective thinking—reflecting while doing;
- explore group processes and techniques, including (1) brainstorming—sharing ideas, (2) synectics— leader-directed problem solving, (3) nominal group techniques—facilitated group problem solving among peers, (4) systems and force field analysis—reviewing a problem's context, (5) orientation—analyzing group problem-solving styles, and (6) controlled orientation—developing a group consensus on the statement of the problem; and

- teach problem-solving processes, such as the Juran Model, the Friedman and Yarborough Comprehensive Model, the Workplace Basics Model, problem analysis, investigating assumptions, identifying tentative solutions, evaluating alternative solutions, and selecting and implementing a solution and using feedback to modify it.

What Constitutes Competency? Problem solving involves several competencies:

- workers should be aware of alternative problem-solving styles.
- workers should understand how to recognize, define, and analyze problems.
- workers should be familiar with problem-solving tools as well as systematic individual and group processes for problem solving.

Because problems do not come neatly packaged for resolution by standard techniques, competency is ultimately measured by proven performance on the job. Tests for problem-solving ability should be performance oriented and competency based.

ADAPTABILITY: CREATIVITY SKILLS

The ability to solve problems involves a significant measure of creativity. Creativity is a continuum of thinking and application including (1) creative thinking—breaking traditional patterns of thought, (2) inventiveness—turning a creative idea into practical applications, and (3) innovation—applying a creative idea.

What is the Curriculum? Creativity curriculums presume a depth of knowledge and experience in a particular subject area and teach the ability to reframe traditional patterns of thinking and doing. Curriculums:

- develop thinking skills in two categories: rational thinking skills and intuitive thinking skills, and
- develop the escape logical and sequential thought patterns.

What Constitutes Competency? Measures of competency in creativity should show whether employees can think creatively, invent applications, and install innovations at work. Creativity is demonstrated in specific domains and subject areas, and therefore should be measured by performance-based standards.

Developmental Skills: Self Esteem, Goal Setting, Motivation, and Personal and Career Development

DEVELOPMENTAL SKILLS: SELF ESTEEM

Self-esteem skills needed for work are based on the ability to maintain a realistic and positive self-image.

Why Is Self-Esteem Important in the New Economy? A positive self-image gives an individual a firm foundation to reach maximum potential both on and off the job. New and more intense standards for organizational performance require each employee to have a strong, positive sense of self. Accepting responsibility for organizational performance beyond one's formal work assignment is necessary to ensure high quality and requires a positive self-image. Self-esteem is also necessary to manage the growing intensity of interaction with co-workers and customers. Increased personal autonomy requires self-confident workers. Overall, the capacity to cope with the fast pace of change at work demands employees who are confident in their own abilities.

What is the Curriculum? The curriculum for self-esteem uses experience, reflection, and counseling to help the employee:

- build self-awareness, including awareness of his or her own skills and abilities, impact on others, and emotional capacity and personal needs;
- build a positive and realistic self-image; and
- build self-esteem.

What Constitutes Competency? The skills that lead to greater self-esteem are highly personal and diverse. Therefore, competency can be only partially measured by norm-referenced scales. Workers can demonstrate competency in self-esteem skills by:

- demonstrating a willingness to take risks;
- leading and taking responsibility;
- functioning in an ambiguous and flexible environment; and
- following through on tasks.

DEVELOPMENTAL SKILLS: MOTIVATION AND GOAL SETTING

Motivation at work involves ability to translate work into an instrument for the development of the self and the realization of potential. Goal setting is the ability to set performance targets that are consistent with goals for personal development. Motivation and goal setting are inextricably intertwined. Motivation inspires goal setting and goal setting clarifies and connects us to our deepest motivations.

Why Are Motivation and Goal Setting Important in the New Economy? The velocity of change is accelerating at work. Flexible organizations and technologies are giving workers more autonomy and increasing the intensity of interaction among co-workers and between employees and customers. These changes require that employees become personally and actively engaged on the job. In addition, as the locus of responsibility for overall performance resides more with the individual, employees must assume responsibility for motivating themselves and setting goals.

What is the Curriculum? The curriculum for teaching motivation and goal setting begins with individual self-assessment and ends with application in the work group. The usual sequence of learning in the curriculum is as follows:

- develop an awareness of personal motivations and cognizance of appropriate goals;
- structure a hierarchy of goals (integrating short-and long-term goals as well as job-related and personal goals);
- define strategic steps to reach goals;
- measure progress;

- negotiate goals with others;
- identify resources for setting goals; and
- revise goals in light of new information and experience.

What Constitutes Competency? Competency in motivation and goal setting is not demonstrated at a single point in time. Rather, it is reflected in a person's ability over time to:

- envision, set, and meet defined objectives;
- be motivated by personal goals rather than goals set by others;
- set realistic goals and understand obstacles; and
- find the resources to overcome obstacles.

DEVELOPMENTAL SKILLS: PERSONAL AND CAREER DEVELOPMENT

Personal and career development skills allow individuals to adapt to changing work requirements in a way that ensures employment security and fulfills personal potential.

Why Are Personal and Career Development Skills Important in the New Economy? New requirements for competitive, organizational, and technical flexibility have reduced job stability. Employees should expect to have to change as job requirements change. Lifetime employment in the same job or even with the same employer is no longer a realistic expectation. As a result, self-conscious personal and career development is central to employment security as well as individual development and career success.

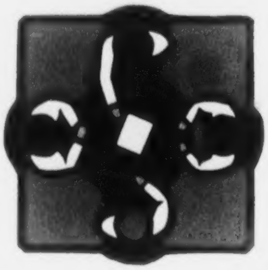
What is the Curriculum? The sequence of learning goals in personal and career development usually begins with a grounding in self-assessment and concludes with the development of a career strategy:

- develop skills useful for finding a job, including self-assessment, reality testing, goal development, and job search competencies such as resume writing;
- develop maturity skills for career development, such as integrative skills (reconciling self-assessment with work assignments) and self-development skills (marketing oneself and using workplace resources for personal career development); and
- develop a career and personal development plan including a hierarchy of short-and long-term goals.

What Constitutes Competency? Ultimately, competency in career development is demonstrated by one's ability to take personal responsibility for career progress. The ability to control and direct our own career progress requires other competencies as well, including such skills as resume writing and interviewing. A variety of instruments are available to test more generic career skills. One such instrument is the Career Mastery Inventory.

Group Effectiveness: Interpersonal Skills, Negotiation, and Teamwork

Why Are Group Effectiveness Skills Important in the New Economy? Work is a group activity. Throughout the postwar era, economists have observed that the major share of productivity improvements results from the ability of work groups to use their human and technical capital more effectively to move up the learning curve. Meeting competitive standards other than productivity also depends on the effectiveness of work groups. For example, high quality is more than the sum of individual excellence. It requires successful interaction throughout the organization. Flexible and fast responses to customers also require effective teamwork. Flexible organizational formats and technologies increase the intensity and importance of group interactions at work. Whenever people work together, successful interaction depends on effective interpersonal skills, formal negotiation to resolve conflict, and successful teamwork.



GROUP EFFECTIVENESS: INTERPERSONAL SKILLS

For example, they need interpersonal skills such as the ability to judge appropriateness of behavior, cope with undesirable behavior, absorb stress, deal with ambiguity, share responsibility, and interact comfortably with others.

What is the Curriculum? The curriculum for interpersonal skills is a sequential learning program delivered in a group setting:

- assess interpersonal needs and styles through instruments such as the FIRO-B Scale;
- establish interpersonal credibility by conducting training in areas such as cross-cultural awareness and communication skills;
- to encourage familiarity among group members, conduct personal sharing exercises involving interviewing, active listening, values clarification, and nonverbal communication;
- build skills needed for forming attachments, such as skills in disclosure, process observation, giving feedback, and oral communication; and
- develop role clarification skills through exercises in role negotiation and goal setting.

What Constitutes Competency? Competency is generally measured by the subjective evaluation of people who interact with the employee. The assessment should focus on the extent to which the employee is positive and proactive in group settings.

GROUP EFFECTIVENESS: NEGOTIATION

They need negotiation skills to overcome disagreements by compromising with, accommodating, and collaborating with others.

What is the Curriculum? The curriculum for negotiation uses a variety of group exercises and techniques in order to:

- develop awareness, problem-solving, and communication skills by separating subjective personalities from objective problems;

- explore problem-solving techniques for establishing individual interests and common interests among stakeholders involved in the negotiation;
- develop problem-solving, interpersonal, and creativity skills to invent options for mutual gain; and
- show how to develop objective criteria for evaluating personal interests and available options.

What Constitutes Competency? Competency in negotiation skills includes:
- the proven ability to assess individual negotiation styles and
- demonstrated knowledge of negotiation techniques. Peers, supervisors, and customers can provide assessments of an employee's negotiation skills and effectiveness.

GROUP EFFECTIVENESS: TEAMWORK SKILLS

Teamwork skills relate to the ability of groups to pool human talents to pursue common goals.

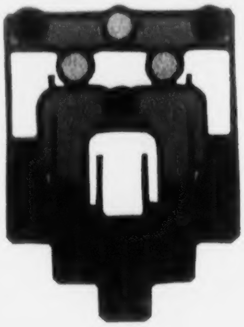
What is the Curriculum? The curriculum for teamwork concentrates on individual abilities usually learned best in structured work groups. Exercises focus on the needs of the group, including the ability to:
- assess individual and team capabilities;
- establish, clarify, and communicate team goals;
- plan and set performance standards; and
- provide feedback, coaching, and motivation.

What Constitutes Competency? A competent team makes maximum use of the human talents available to pursue shared goals. Competence includes both awareness of team concepts and teamwork skills. Competence can be measured by:
- outcome measures of team efforts, including productivity, quality, flexibility, and speed, and
- review of team performance by peers and customers.

Influencing Skills: Organizational Effectiveness and Leadership Skills

INFLUENCING SKILLS: ORGANIZATIONAL EFFECTIVENESS

Organizational effectiveness skills needed for work include the ability to work effectively in the context of explicit and implicit organizational cultures and subcultures.



Why Is Organizational Effectiveness Important in the New Economy? An organization is a maze of explicit and implicit power structures and cultures. Understanding how to operate within the organizational maze is key to peak performance in the new economy. Networks driven by common goals and information are supplanting both rigid hierarchies and fragmented structures. Workers will require strong organizational skills to participate effectively in the new networks. Also, because of increasing independence on the job, workers will need organizational skills to align their own efforts and goals with those of the organization and thereby minimize friction and wasted effort.

What is the Curriculum? Curriculum in organizational effectiveness teaches an appreciation of institutional cultures, explores organizational limits and opportunities, and actively includes the trainee as a member and owner of the organization. Specifically, the curriculum should:

- provide the employee with an understanding of what organizations are, why they exist, and how one can navigate in the complex social waters of varying types of organizational structures;
- expose the employee to the organizational structure of his or her employer and industry network—discussing goals, values, culture, and traditional modes of operation; and
- train the employee in interpersonal, group effectiveness, and communication skills.

What Constitutes Competency? Competency in organizational skills includes:

- a demonstrated awareness of organizational types and of skills and behaviors that encourage alignment between the organization and employees;
- a demonstrated awareness of the implicit and explicit structures in the employee's own organization and industry network; and
- knowledge of relevant skills, including communications, personal management, and group effectiveness. Mastery is best measured by performance-oriented, competency-based instruments. More generic instruments such as the Career Mastery Inventory can be useful for initial assessments and to chart progress. Assessments of co-workers, customers, and superiors are also useful.

INFLUENCING SKILLS: LEADERSHIP

Leadership skills at work involve influencing others to serve the strategic purpose of an organization or the developmental needs of an individual.

Why is Leadership Important in the New Economy? The pace of change and competitive standards in the new economy require workers to assume leadership roles beyond their own formal assignments. Moreover, the new economic environment requires fluidity in leadership roles; every person at every level of an organization may need to assume a leadership role at one time or another, depending on the requirements of the task at hand. In addition, the growing utilization of more flexible technologies and organizational networks is creating more fluid work processes that demand spontaneous leadership.

What is the Curriculum? Curriculum in leadership begins with awareness of leadership styles and functions and then proceeds to the development of leadership skills and behaviors. A typical curriculum helps trainees to:

- develop an awareness of leadership approaches;
- develop leadership skills, such as personal management, group effectiveness, adaptability, and influencing skills; and
- develop leadership behaviors, such as developing and communicating a vision, developing commitment, inspiring effort, and modeling appropriate behaviors (e.g., taking risks, being consistent, being trustworthy, showing respect for others, and tolerating ambiguity).

What Constitutes Competency? At its most elementary level, leadership is the demonstrated ability to influence others to act. Competency measures are limited and subjective:

- demonstrated awareness of leadership theories and associated skills and
- subjective assessment by peers, customers, and superiors.

REFERENCES

Abernathy, W., Clark, K., and Kantrow, A. *Industrial Renaissance: Producing A Competitive Future for America.* New York, N.Y.: Basic Books, 1983.

Abraham, K. "Restructuring the Employment Relationship: The Growth of Market-Mediated Work Arrangements." College Park, Md.: University of Maryland, 1988.

Adams, C. *The Straight Dope: Answers to Questions That Torment Everyone.* New York, N.Y.: Ballantine, 1984.

Adler, P. "Managing Flexible Automation." *Harvard Business Review*, July-August, 1988.

Adler, P. "New Technologies, New Skills." *California Management Review*, Fall, 1986.

Albrecht, K., Zemke, R. *Service America!* Homewood, Ill.: Dow Jones-Irwin, 1985

Albrecht, K. *At America's Service.* Homewood, Ill.: Dow Jones-Irwin, 1988.

Allaire, P., Rickard, E. "Quality and Participation at Xerox." *Journal for Quality and Participation*, Vol. 12-1. March, 1989.

Arendt, H. *The Human Condition.* Chicago, Ill.: University of Chicago Press, 1970.

Bailey, T. "Changes in the Nature and Structure of Work: Implications for Skill Demand." National Assessment of Vocational Education, 1988a.

Bailey, T. "Changes in the Nature and Structure of Work: Implications for Employer Sponsored Training" prepared for Conference on Employer-sponsored Training, Alexandria, Va., December, 1988b.

Bailey, T. "Education and the Transformation of Markets and Technology in the Textile Industry." Technical Paper No. 2 prepared for the National Center on Education and Employment, Teachers College, Columbia University, April, 1988c.

Bailey, T. , Noyelle, T. "New Technology and Skill Formation: Issues and Hypotheses." New York, N.Y.: National Center on Education and Employment, Teachers College, Columbia University, 1988.

Barra, R. "Motorola's Approach to Quality." *Journal for Quality and Participation*, Vol. 12-1. March, 1989.

Baran, B., Parsons, C. "Technology and Skill: A Literature Review," prepared for the Carnegie Forum on Education and the Economy, Berkeley Roundtable on the International Economy (BRIE), January, 1986.

Bell, D. *The Coming of Post-Industrial Society: Adventure in Social Forecasting.* New York, N.Y.: Basic Books, 1983.

Berger, S. "The U.S. Textile Industry: Challenges and Opportunities." *The Working Papers of the MIT Commission on Industrial Productivity, Vol. 2.* Cambridge, Mass.: The MIT Press, 1989.

Berger, P., Luckmann, T. *Social Construction of Reality: A Treatise in the Sociology of Knowledge.* New York, N.Y.: Irvington Publishing, 1966.

Berryman, S. "Shadows in the Wings: The Next Educational Reform," Occasional Paper No. 1, presented at The Education Policy Forum sponsored by the American Educational Research Association and the Institute for Educational Leadership. Washington, D.C.: March 13, 1987.

Bertrand, O., Noyelle, T. *Human Resources and Corporate Strategy.* Paris: Organization for Economic Cooperation and Development, 1988.

Bishop, J. "Achievement, Test Scores, and Relative Wages," Conference Paper, American Enterprise Institute for Public Policy Research. Washington, D.C.: 1989.

Blackburn, P., Coombs, R., and Green, K. *Technology, Economic Growth and the Labour Process.* New York, N.Y.: St. Martin's Press, 1985.

Bound, J., Johnson, G. "Wages in the United States During the 1980s and Beyond." Conference Paper, American Enterprise Institute for Public Policy Research. Washington, D.C.: 1989.

Bozdogan, K. "The Transformation of the U.S. Chemicals Industry." *The MIT Commission on Industrial Productivity, Volume 1.* Cambridge, Mass.: The MIT Press, 1989.

Brandt, R. "Chips Are Down But Not For Long." *Business Week*, January 8, 1990.

Braverman, H. *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century.* New York, N.Y.: New York Monthly Review Press, 1974.

Carnevale, A. *Jobs for the Nation: Challenges for a Society Based on Work.* Alexandria, Va.: American Society for Training and Development, 1985.

BEST COPY AVAILABLE

REFERENCES

Carnevale, A., Gainer, L. *The Learning Enterprise.* Washington, D.C.: U.S. Department of Labor and American Society for Training and Development, 1989.

Carnevale, A., Gainer, L., and Meltzer, A. *Workplace Basics: The Essential Skills Employers Want.* San Francisco, Calif.: Jossey-Bass Publishers, 1990.

Carnevale, A., Gainer, L., and Meltzer, A. *Workplace Basics: The Skills Employers Want.* Washington, D.C.: U.S. Department of Labor and American Society for Training and Development, 1989.

Carnevale, A., Gainer, L., and Shultz, E. *Training the Technical Work Force.* San Francisco, Calif.: Jossey-Bass Publishers, 1990.

Carnevale A., Gainer, L., and Villet, J. *Training in America: The Organization and Strategic Role of Training.* San Francisco, Calif.: Jossey-Bass Publishers, 1990.

Clark, K., Chew, W., and Fujimoto, T. "Product Development in the World Auto Industry." Brookings Papers on Economic Activity, 3: 1987. Washington, D.C.: The Brookings Institution, 1987.

Clausing, D. "The U.S. Semiconductor, Computer, and Copier Industries." In *The Working Papers of the MIT Commission on Industrial Productivity, Volume 2.* Cambridge, Mass.: The MIT Press, 1989.

Denison, E. *Accounting for United States Economic Growth 1929-1969,* Washington, D.C.: The Brookings Institution, 1974.

Denton, D.K. *Quality Service.* Houston, Tex.: Gulf Publishing Company, 1989.

Dertouzos, M., Lester, R., and Solow, R. *Made in America.* Cambridge, Mass.: The MIT Press, 1989.

Desatnick, R. *Managing to Keep the Customer.* San Francisco, Calif.: Jossey-Bass Publishers, 1987.

Doz, Y. "International Industries: Fragmentation Versus Globalization." *Technology and Global Industry: Companies and Nations in the World Economy.* Washington, D.C.: National Academy Press, 1987.

Dumaine, B. "How Managers Can Succeed Through Speed." *Fortune,* February 11, 1989.

Duncan, A. "It's A Lot Tougher To Mind The Store." *Business Week,* January 8, 1990.

Edwards, R. *Contested Terrain: The Transformation of the Workplace in the Twentieth Century.* New York, N.Y.: Basic Books, 1979.

Ergas, H. "Does Technology Policy Matter?" *Technology and Global Industry: Companies and Nations in the World Economy.* Washington, D.C.: National Academy Press, 1987.

Fairbank, J., Reischauer, E., and Craig, A., *East Asia: Tradition and Transformation.* Boston, Mass: Houghton Mifflin Company, 1978.

Feigenbaum, A. "Seven Keys to Constant Quality." *Journal for Quality and Participation.* Vol. 12-1. March, 1989.

Felgner, B. "Specialty Foods." *Supermarket Business,* September, 1988.

Flemings, M. "The Future of the U.S. Steel Industry in the International Marketplace." *The Working Papers of the MIT Commission on Industrial Productivity, Volume 2.* Cambridge, Mass.: The MIT Press, 1989.

Flynn, P. *Preparing Workers and Organizations for Technological Change: A Life-Cycle Perspective.* 1989.

Ford, G.W. "Innovations in Post-School Skill Formation Markets." Presentation for the U.S./O.E.C.D. seminar on Technological Change and Human Resource Development. Washington, D.C.: June, 1989.

Freedman, A. "Productivity Needs of the United States." Report No. 934. New York, N.Y.: The Conference Board, 1989.

Fullerton, H. "New Labor Force Projections, Spanning 1988 to 2000." *Monthly Labor Review.* Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, November, 1989.

Galvin, R. "Statement on Motorola's Quality Experience." November, 1988.

Garraty, J.A. *Unemployment in History: Economic Thought and Public Policy.* New York, N.Y.: Harper and Row, 1979.

Gibbs, G. *The Saco-Lowell Shops.* New York, N.Y.: Russell and Russell, 1950.

BEST COPY AVAILABLE

Goldhar, J., Jelinek, M. "Plan for Economies of Scope." *Harvard Business Review*, November-December, 1983.

Goldstein, H., Fraser, B.S. "Training for Work in the Computer Age: How Workers Who Use Computers Get Their Training." Washington, D.C.: U.S. Department of Labor, National Commission for Employment Policy, June, 1985.

Gomory, R., Schmitt, R. "Science and Product." *Policy Forum*, May 27, 1988.

Grayson, C., O'Dell, C. *American Business: A Two-Minute Warning*. New York, N.Y.: The Free Press, A Division of Macmillan, Inc., 1988.

Guile, B., Brooks, H. (eds.) *Technology and Global Industry: Companies and Nations in the World Economy*. Washington, D.C.: National Academy Press, 1987.

Hampton, W. "Why Image Counts: A Tale of Two Industries." *Business Week*, June 8, 1987.

Hayes, R., Garvin, D. "Managing for Tomorrow." *Harvard Business Review*, May-June, 1982.

Hirsch, E. *Cultural Literacy: What Every American Needs to Know*. Boston, Mass.: Houghton Mifflin Company, 1987.

Hirschhorn, L. "The Post-Industrial Economy: Labour, Skills and the New Mode of Production." *The Service Industries Journal*, December, 1988.

Hochschild, A., Machung, A. *The Second Shift: Inside the Two-Job Marriage*. New York, N.Y.: Viking-Penguin, 1989.

Hodder, J. and Riggs, H. "Pitfalls in Evaluating Risky Projects." *Harvard Business Review*, January-February, 1985.

Hoerr, J. "Work Teams Can Rev Up Paper-Pushers, Too." *Business Week*, November 28, 1988.

Hutchins, D., "Having a Hard Time With Just-In-Time." *Fortune*, June, 1986.

Ingrassia, P., Patterson, G. "Is Buying a Car a Choice or a Chore?" *The Wall Street Journal*, October 24, 1989.

Johnston, R., Lawrence, P. "Beyond Vertical Integration—The Rise of the Value-Adding Partnership." *Harvard Business Review*, July-August, 1988.

Johnston, W., Packer, A. *Workforce 2000: Work and Workers for the 21st Century*. Indianapolis, Ind.: Hudson Institute, 1987.

Juhn, C., Murphy, K., and Pierce, B. "Accounting for the Slowdown in Black-White Wage Convergence." Conference Paper, American Enterprise Institute for Public Policy Research. Washington, D.C.: 1989.

Kelly, H.C. Calculated from National Income and Product Accounts tables 7.10 and 6.88 from historical diskettes issued July, 1989.

Kendrick, J. "Managing Quality in Steel." *Quality Digest*, May, 1988.

Kerr, C. *The Future of Industrial Societies: Convergence On Continuing Diversity*. Cambridge, Mass.: Harvard University Press, 1983.

Kochan, T., Mitchell, D., and Dyer, L. (eds.) *Industrial Relations Research in the 1970s: Review and Appraisal*. Industrial Relations Research Association Series. Bloomington, Ill.: Pantagraph Printing, 1982.

Kosters, M. "Wages and Demographics." Conference Paper, American Enterprise Institute for Public Policy Research. Washington, D.C.: 1989.

Kuhor, T. *The Structure of Scientific Revolutions*. Chicago, Ill.: University of Chicago Press, 1970.

Kupfer, A. "Personal Investing: Hogs with Wheels." *Fortune*, April 10, 1989.

Kutscher, R.E. "Projections Summary and Emerging Issues." *Monthly Labor Review*. U.S. Department of Labor, Bureau of Labor Statistics. Volume 112, No. 11. Washington, D.C.: Government Printing Office, November, 1989.

LeBoeuf, M. *How to Win Customers and Keep Them for Life*. New York, N.Y.: G. P. Putnam's Sons, 1987.

Lehnerd, A. "Revitalizing the Manufacture and Design of Mature Global Products." *Technology and Global Industry: Companies and Nations in the World Economy*. Washington, D.C.: National Academy Press, 1987.

Levy, F. *Dollars and Dreams: The Changing American Income Distribution*. New York, N.Y.: Russell Sage Foundation, 1987.

Liebergott, S. *The Americans: An Economic Record*. New York, N.Y.: W. W. Norton, 1984.

Litan, R., Lawrence, R., and Schultze, C. (eds.) *American Living Standards.* Washington, D.C.: The Brookings Institute, 1988.

March, A. "The U.S. Commercial Aircraft Industry and Its Foreign Competitors." *MIT Commission on Industrial Productivity, Volume 1.* Cambridge, Mass.: The MIT Press, 1989.

Morris, C. "The Coming Global Boom." *The Atlantic Monthly*, October, 1989.

Murphy, K., and Welch, F. "Wage Differentials in the 1980s: The Role of International Trade." Conference Paper, American Enterprise Institute for Public Policy Research. Washington, D.C.: 1989.

Nasar, S. "Do We Live As Well As We Used To." *Fortune,* September 14, 1987.

National Advisory Committee on Semiconductors. "A Report to the President And the Congress." Washington, D.C.: Government Printing Office, November, 1989.

Noyelle, T. "Services and the New Economy: Toward a New Labor Market Segmentation." New York, N.Y.: National Center on Education and Employment, Teachers College, Columbia University, 1988a.

Noyelle, T. "Skills, Skill Formation, Productivity and Competitiveness: A Cross-National Comparison of Banks and Insurance Carriers in Five Advanced Economies." Washington, D.C.: Conference on Employer-provided Training, Institute on Education and the Economy, Teachers College, Columbia University, 1988b.

Noyelle, T. "Skill Needs In the Service Sector: The Role of Firm-Based Training." Testimony before the Joint Economic Committee, Congress of the United States, Hearings on "Crisis in the Workplace: Mismatch of Jobs and Skills." October 31, 1989.

Pennar, K. "America's Quest Can't Be Half-Hearted." *Business Week,* June 8, 1987.

Personick, V.A. "Industry Output and Employment: A Slower Trend for the Nineties." *Monthly Labor Review.* U.S. Department of Labor, Bureau of Labor Statistics. Volume 112, No. 11. Washington, D.C.: Government Printing Office, November, 1989.

Piore, M., Sabel, C. *The Second Industrial Divide.* New York, N.Y.: Basic Books, 1984.

Port, O. "Special Report - Quality." *Business Week,* June 8, 1987.

Power Report, The, Vol. 11, No. 8, J. D. Power and Associates. August, 1989.

Priestman, S. "Rolm President Tries to Reassure Wary Workers." *San Francisco Examiner,* September 27, 1984a.

Priestman, S. "Area Firms Re-examine Quality-Control Process." *San Jose Mercury News,* March 31, 1985a.

Priestman, S. "Professional Careers: Information Specialists Replacing Librarians." *San Jose Mercury News,* November 25, 1984b.

Priestman, S. "Bringing Quality Home." *Silicon Valley Magazine,* October-November, 1984c.

Priestman, S. "SQC and JIT: Partnership in Quality." *Quality Progress,* May, 1985b.

Razzano, R. "Future Demands Whet Retailers' Appetites." *Chain Store Age Executive,* May, 1987.

Reid, P. *Well Made in America.* New York, N.Y.: McGraw Hill Publishing Company, 1990.

Roach, S. "Pitfalls on the 'New' Assembly Line: Can Services Learn From Manufacturing?" Special Economic Study for Morgan Stanley presented at the O.E.C.D. International Seminar on Science, Technology and Economic Growth in Paris, France, June, 1989.

Robinson, J. "Time's Up," *American Demographics,* July, 1989.

Robinson, J.P. "Trends in Americans' Use of Time: Some Preliminary 1975-1985 Comparisons." Survey Research Center. College Park, Md.: University of Maryland, 1986.

Rosenberg, N. *Inside the Black Box: Technology and Economics.* New York, N.Y.: Press Syndicate of the University of Cambridge, 1982.

Rosenberg, N., Birdsell, L. *How The West Grew Rich: The Economic Transformation of the Industrial World.* New York, N.Y.: Basic Books, 1986.

Sadler, G. unpublished data "Comparative Output and Productivity Patterns. U.S. and Japan, 1970-83." For the American Productivity Center. Houston, Tex.: 1977.

Schiller, Z. "Appliance Repairmen are Getting Lonelier." *Business Week,* June 8, 1987.

Schumpeter, J. *Capitalism, Socialism and Democracy.* New York, N.Y.: Harper and Row, 1989.

Segalla, E. "All for Quality, and Quality for All," *Training & Development Journal.* Alexandria, Va.: American Society for Training and Development, September, 1989.

Silvestri, G., Lukasiewicz, J. "Projections of Occupational Employment, 1988-2000." *Monthly Labor Review.* U.S. Department of Labor, Bureau of Labor Statistics, Volume 112, No. 11. Washington, D.C.: Government Printing Office, November, 1989.

Smith, L. "The Wealth of Nations: The World is Getting Richer." *Fortune*, September 14, 1987.

Spenner, K. "The Upgrading and Downgrading of Occupations: Issues, Evidence, and Implications for Education." *Review of Educational Research*, Summer, 1985.

Stalk, G. "Time—The Next Source of Competitive Advantage." *Harvard Business Review*, July-August, 1988.

Stokes, B. "Coping with Glut." *National Journal*, Pages 2608-14. November 1, 1986.

Stromberg, R. *An Intellectual History of Modern Europe.* Englewood Cliffs, N.J.: Prentice Hall, 1975.

Technical Assistance Research Programs Institute. *Consumer Complaint Handling in America: An Update Study Part II.* Washington, D.C.: U.S. Office of Consumer Affairs, 1986.

Teece, D. "Capturing Value from Technological Innovation: Integration, Strategic Partnership, and Licensing Decisions." in *Technology and Global Industry: Companies and Nations in the World Economy.* Washington, D.C.: National Academy Press, 1987.

United Kingdom, Treasury. *Economic Progress Report*, No. 201, April, 1989. London: Colibri Press Ltd., 1989.

U.S. Congress, Office of Technology Assessment. *Technology and the American Economic Transition: Choices for the Future.* Washington, D.C.: U.S. Government Printing Office, 1988.

U.S. Department of Commerce, Bureau of the Census. News CB89-190. Washington, D.C.: Government Printing Office, December 7, 1989a.

U.S. Department of Commerce, Bureau of the Census. *Statistical Abstract of the United States 1989.* Washington, D.C.: Government Printing Office, 1989b.

U.S. Department of Commerce, Bureau of the Census. *U.S. Industrial Outlook.* Washington, D.C.: Government Printing Office, 1989c.

U.S. Department of Labor, Bureau of Labor Statistics. USDL: 89-322. Washington, D.C.: Government Printing Office, 1989.

Utterback, J. "Innovation and Industrial Evolution in Manufacturing Industries." *Technology and Global Industry: Companies and Nations in the World Economy.* Washington, D.C.: National Academy Press, 1987.

Verity, J. "Another Crunch for Computer Makers." *Business Week*, January 8, 1990.

Vernon, R. "Coping with Technological Change: U.S. Problems and Prospects." *Technology and Global Industry: Companies and Nations in the World Economy.* Washington, D.C.: National Academy Press, 1987.

Walton, R. "From Control to Commitment in the Workplace." *Harvard Business Review*, March-April, 1985.

Weber, J. "Getting Cozy With Their Customers." *Business Week*, January, 8, 1990.

Wei, J. "The Transformation of the U.S. Chemicals Industry." *The Working Papers of the MIT Commission on Industrial Productivity Volume 1.* Cambridge, Mass.: The MIT Press, 1989.

Wheelwright, S. and Hayes, R. "Competing Through Manufacturing." *Harvard Business Review*, January-February, 1985.

Womack, J. "The U.S. Automobile Industry in an Era of International Competition: Performance and Prospects." *The Working Papers of the MIT Commission on Industrial Productivity Volume 1.* Cambridge, Mass.: The MIT Press, 1989.

Willis, R. "Harley-Davidson Comes Roaring Back." *Management Review*, March, 1986.

Zemke, R., Schaaf, D. *The Service Edge.* New York, N.Y.: NAL Penguin, Inc., 1989.

Zuboff, S. *In the Age of the Smart Machine: The Future of Work and Power.* New York, N.Y.: Basic Books, 1988.

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